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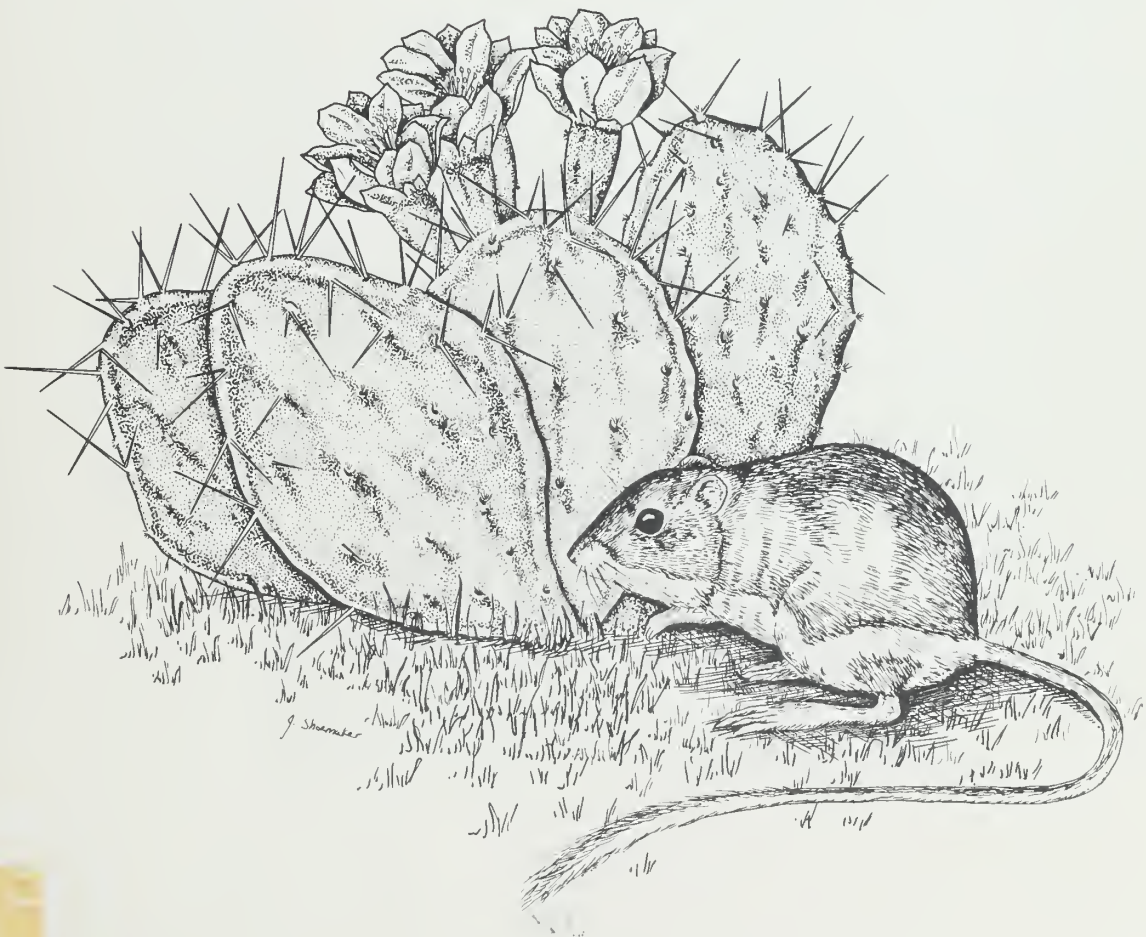
Wildlife Guilds in Arizona Desert Habitats

by Henry L. Short



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February 1983

WILDLIFE GUILDS IN ARIZONA DESERT HABITATS

by

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PREFACE

This report summarizes information produced from Interagency Agreement No. AA-851-IA1-27 between the Bureau of Land Management (BLM), USDI, and the Fish and Wildlife Service (FWS), USDI. The contract was instrumental in the final development of the guilding methodology and was responsible for the development of wildlife guilds for the Hualapai-Aquarius planning area of the BLM in westcentral Arizona, reported herein. The Arizona study area was selected for the application of the guilding technology because a thorough assessment of the floral and faunal resources had recently occurred in conjunction with the development of a grazing Environmental Impact Statement (EIS). Thus, the association of wildlife species with habitat type was well known, which aided in the compilation of the data base necessary for the development of guilds. Some data were also available that described the vegetative structure of habitats. This was useful in the development of a model that evaluated the quality of habitat on the basis of the diversity of cover in those habitats (Short 1982).

I appreciate the early interest in the guilding technology expressed by Drs. R. G. Streeter, and W. B. Krohn, FWS, and D. Seibert and K. Hamilton, BLM, which led to the development of this cooperative research contract. Dr. K. P. Burnham, Western Energy and Land Use Team, cheerfully provided many hours of highly skilled effort in developing a variety of computer programs for the overall guilding effort. Dr. M. Call, BLM, provided early liaison with the Phoenix District Office. This function was later assumed by Dr. A. Cooperrider. Finally, T. Cordery, L. Kepner, W. Kepner, B. Millsap, D. Schaffer, J. Zook, and R. Hall of the Phoenix District Office either aided in the development of the data base for the guilding technology or provided copies of original field data which I used in the present study.

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WILDLIFE GUILDS: THEIR FORMATION AND UTILITY IN RESOURCE PLANNING

The following chapter serves three functions: (1) it describes the biological premises basic to the development of wildlife guilds; (2) it describes how wildlife guilds are formed; and (3) it describes an application of the community guild model to resource planning. This chapter is meant both as an introduction to the present publication and as a summary document describing the guilding process for biologists, planners, and managers of natural resources.

PREMISES BASIC TO THE DEVELOPMENT OF WILDLIFE GUILDS

The community guild model is a planning tool for biologists, managers, and project planners. As a tool, the guild model has both advantages and limitations. The most important advantage is that wildlife species are associated with the structure of habitats in a way that is relevant to other land resources and that allows the evaluation of impacts of a variety of land-use actions on the total wildlife community. The main limitation is that

the model is not highly predictive of the quality of habitat for an individual species.

The community guild model emphasizes the following premise. It is far easier and ecologically more desirable to plan from an integrated general model than to try to develop general management plans by combining comprehensive information about individual wildlife species. One can always disaggregate from the general model if it is necessary to evaluate habitats for individual species of special interest. The importance of the guild process is that it provides the linkage between species and habitat so that effects of land-use on the total wildlife community can be evaluated. The linkage is simple in concept, easy to apply, and provides a framework for many land management activities.

The community guild model is based on three premises. One, while it is often difficult to describe the niche of a species it is relatively easy to position that niche in the volume of space that comprises a habitat. The second premise is that wildlife species are associated with the structure of habitats and habitat structure can be considered in terms of layers of habitat. Familiar layers of habitat include the surface water layer, the terrestrial surface or understory layer, the shrub or midstory layer, and the tree crown or overstory canopy layer. The third premise is that, as more layers of habitat occur in a cover type, more niches can be accommodated, and more wildlife species will occur.

Layers of habitat, in the community guild model, are the common denominator for describing the wildlife community and impacts of land-use changes on the wildlife community. Layers of habitat can be measured, inventoried, and evaluated. These efforts are important management activities because vegetative layers provide the habitat structure supporting the wildlife community. Thus, the wildlife potential of a cover type can be predicted with some assurance by measuring the areas of different layers of habitat. The effects of a proposed land-use change can be directly measured by comparing the areas of layers of habitat that will be present after proposed land-use change occurs with areas of layers of habitat that are present before the land-use change.

The guild process relates wildlife species to layers of habitat. This is accomplished by selecting two very important niche parameters for which species-habitat information is likely to be available. The two parameters become the axes of a simple matrix. The x-axis of the matrix lists layers of habitat where breeding (nesting, hatching, or birthing) occurs, and the y-axis of the matrix lists layers of habitat where foraging occurs. The y-axis of the matrix is divided so that guilds of primary consumers (plant eaters) and secondary consumers (animal eaters) can both be developed. Each wildlife species is positioned within this species-habitat matrix by determining the layer or layers of habitat required for feeding and the layer or layers of habitat required for successful reproduction. The species is placed in the guild blocks that are formed from the intersection of habitat layers on the x-axis and the y-axis of the matrix. Guilds of wildlife species are developed by using a simple computerized sort-and-merge routine. The guilds consist of

one or more wildlife species that use the same guild block or series of guild blocks. Species within a guild share a dependency on the same layers of habitat and will be affected in about the same way if those layers of habitat are impacted through land-use change.

Wildlife guilds represent the potential wildlife community that can occur in a cover type. The actual wildlife community present can be estimated with inventory information. The guild process aids inventory activities by providing a framework for: (1) planning field surveys; (2) determining the adequacy of field survey efforts; (3) interpreting the results of field surveys; and (4) relating animal inventory information to other land-use activities by providing a common denominator for discussion and analysis because wildlife guilds are tied to layers of habitat. Species-habitat models also provide more interpretable information to the manager when the species are treated as members of wildlife guilds. The justification for the community guild model is that wildlife species are tied to the structure of habitat in a way that is relevant to other land resources and the model provides a wildlife community framework in which more intensive study of individual species can occur, if necessary. Wildlife guilds and the wildlife species comprising each guild are listed in the Final Report for each of 14 cover types that occur within the Hualapai-Aquarius planning units of westcentral Arizona. The importance of each layer of habitat to the wildlife community within a cover type is explained. This provides an example of how land-use impacts can be evaluated for the total wildlife community. Many cover types within the Sonoran desert provide three layers of habitats: a subsurface layer that provides cover for

burrowing animals; a surface layer that acts as both a foraging and reproductive substrate; and a midstory layer. The saguaro cactus in saguaro-palo verde habitats is a good example of the importance of a habitat layer to the wildlife community. The major difference between the wildlife community in saguaro-palo verde and desert shrub communities is the presence of cavity producing and cavity nesting vertebrates where the large saguaro provides a fourth habitat layer, analogous to the tree bole. Destruction of the saguaro removes this habitat layer and produces a wildlife community similar to that of desert shrub communities.

Riparian streamers are also important habitats in the Hualapai-Aquarius planning units because they provide aquatic habitat layers in addition to the terrestrial surface, midstory, tree bole, and tree canopy layers. Riparian communities can have more layers of habitat, more guild blocks, and provide habitat to more wildlife guilds and species than do other habitat types. Unfortunately, these habitats are also in shortest supply in the planning units. The community guild model, in this example, provides a mechanism for determining the relative importance of habitats to the wildlife community. Those habitats that provide the greatest number of layers of habitat and are in shortest supply should be managed most intensively for their wildlife values. Habitats that are both abundant and provide few layers of habitat are the best candidates for land-use change because development in these habitats will generally have the least detrimental effect on the wildlife community. The presence and need to manage threatened and endangered species may obviously affect these management concepts.

Premises basic to the establishment of the community guild model are validated in the Final Report. The validation used data about the structure of inventory plots in different cover types on the Hualapai-Aquarius planning units and the birds present in those inventory plots during springtime. The number of guilds of birds present increased significantly as the number of guild blocks increased; the number of species of birds on the study plots also increased as the number of guild blocks and the quality of cover increased. This suggests that the community guild model is based on structural components of the habitat that are important to the wildlife community.

Equations predicting the number of wildlife guilds with birds and the number of breeding bird species on standard transects were developed from data for the Hualapai-Aquarius planning units. These equations were used to estimate the number of guilds with birds and the number of breeding birds on transects in the neighboring Lower Gila North planning units. The predicted number of guilds with birds and of species of breeding birds was highly correlated with the number of guilds and the number of species of breeding birds actually found on 14 transects in the Lower Gila North planning units. Results of this test application suggest that the wildlife species-habitat relationships developed in the Hualapai-Aquarius planning units may have application throughout the Ecoregion.

DEVELOPMENT OF WILDLIFE GUILDS

This section describes the steps involved in developing guilds of wildlife species to help evaluate the impacts of land-use change on the wildlife community. The examples cited below were selected from the RESULTS section of the present publication. The steps describe the general process used to identify wildlife guilds in a particular habitat type.

1. Bound the study area.

   Wildlife guilds are developed for some bounded area within an ecoregion (Bailey, R. G. 1978. Description of the Ecoregions of the United States. USDA Forest Service. Intermtn. Reg. Ogden, UT. 77 pp). Ecoregions are generally characterized by a distinctive flora, fauna, climate, landform, soil, vegetation, and ecological climax. Ecological relationships between plant species, soil, and climate are essentially similar within an ecoregion, and similar management treatments give comparable results. Ecoregions present in a portion of the southwestern United Sates are indicated in Figure 1.

2. Determine the cover types present within the Ecoregion.

   Chaparral, cottonwood-willow riparian, creosote bush-white bursage, desert grassland, juniper-mixed shrubs, joshua tree-creosote bush, lentic, mixed riparian scrub, mesquite-tamarisk riparian, pinyon-juniper, and saguaro-palo verde are cover types present in Ecoregion 3222 (Fig. 1).

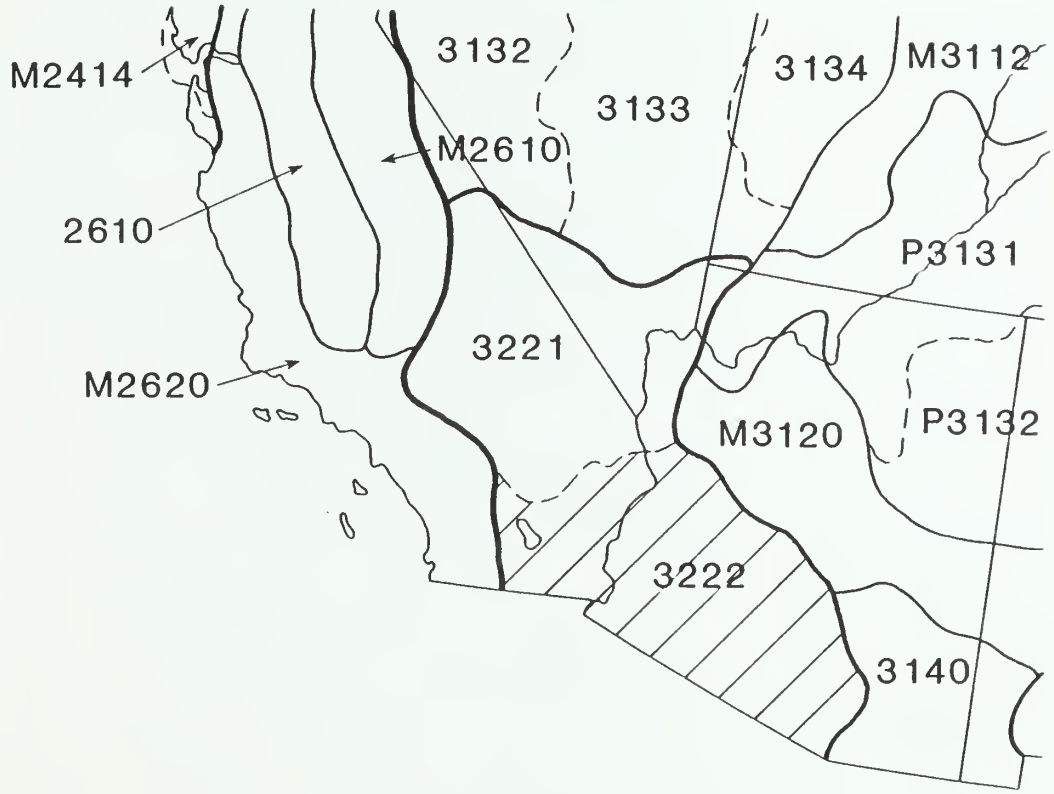


Figure 1. Delineation of ecoregions in the southwestern United States.

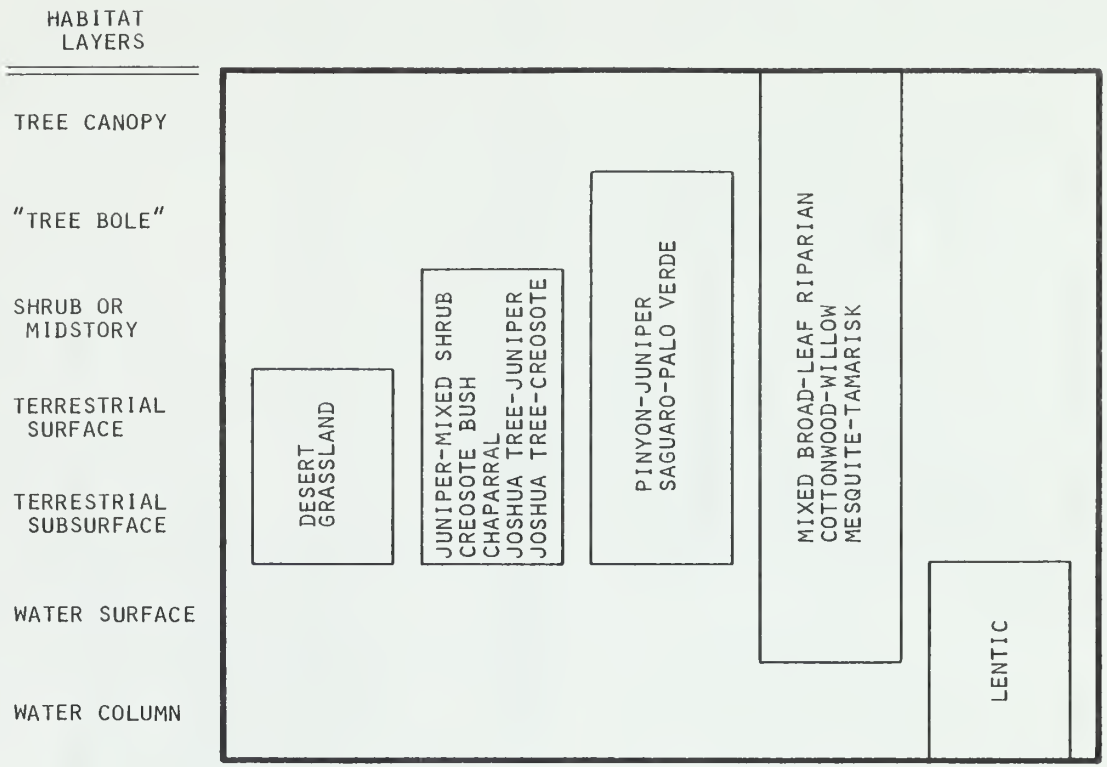


Figure 2. Cover types within the Sonoran desert provide different habitat layers for wildlife.

These cover types contain different layers of habitat (Fig. 2) in which wildlife species can live. Wildlife guilds and species vary between cover types because vegetation structure varies between cover types. For example, the desert grassland cover type provides only subsurface and surface layers of habitat; creosote bush-white bursage, chapparal, joshua tree-creosote bush, juniper-mixed shrub, and mixed riparian scrub cover types provide subsurface, terrestrial surface, and midstory layers of habitat; pinyon-juniper and saguaro-palo verde habitats may provide an additional "tree-bole" layer of habitat. Riparian habitats with mature trees can provide still more layers of habitat, including tree canopy and water surface layers. In the wildlife guild model, cover types are considered in terms of the number of habitat layers they provide for wildlife species.

3. Develop lists of wildlife species occurring within the Ecoregion by cover type (Table 1).

This effort relies heavily on published literature and biological surveys.

4. Develop the species-habitat matrix.

Two very important niche parameters, habitat layers where feeding occurs and habitat layers where breeding (nesting, hatching, and birthing) occurs, are used as the two axes of the species-habitat matrix (Fig. 3). A species-habitat matrix is developed for each cover type in the Ecoregion. Both axes of the species-habitat matrix formed for a cover type

Table 1. A partial list of wildlife species occurring in different cover types within Ecoregion 3222.

SPECIES COMMON NAME	HABITAT COVER TYPES WITHIN ECOREGION 3222							
	CHAPARRAL	COTTONWOOD-WILLOW	CREOSOTE BUSH-WHITE BURSAGE	DESERT GRASSLAND	JUNIPER-MIXED SHRUB	JOSHUA TREE-CREOSOTE BUSH	LENTIC	ETC.
BIRDS:								
ABERT'S TOWHEE		CW						
ACORN WOODPECKER	C	CW			JMS			
AMERICAN AVOCET							L	
AMERICAN BITTERN		CW						
AMERICAN COOT		CW					L	
AMERICAN GOLDFINCH	C	CW		DG	JMS			
AMERICAN KESTREL	C	CW	CWB	DG	JMS	JTC		
AMERICAN REDSTART		CW						
AMERICAN ROBIN	C	CW		DG	JMS			
AMERICAN WIGEON							L	

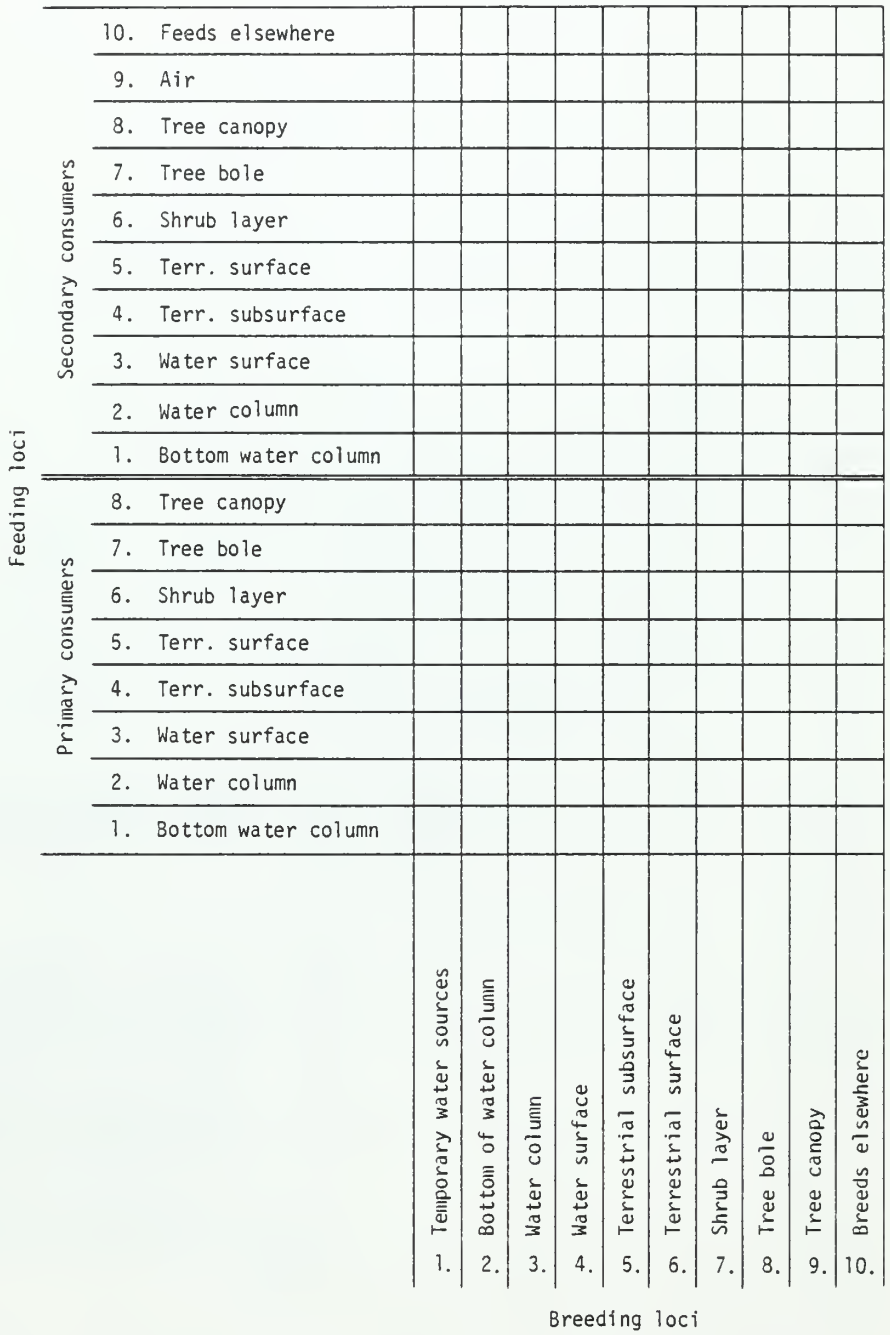


Figure 3. Form of the species-habitat matrix used in the development of wildlife guilds.

contain all of the layers of habitat present in that cover type. The y-axis of the matrix is arranged so that the feeding loci of primary consumers can be separated from the feeding loci of secondary consumers. Therefore, guilds of primary and secondary consumers can both be developed. An omnivorous species may occur with one group of species while a primary consumer and with a different group of species while a secondary consumer.

5. Determine for each wildlife species in each cover type:

   a. The layer or layers of habitat where that species breeds.

   b. The layer or layers of habitat where that species feeds.

   This step requires thorough literature searches and sound professional judgement because many compilations of natural history information do not describe wildlife species as occupants or users of particular layers of habitat.

   Wildlife species, at this step in the guilding process, are positioned within guild blocks in the matrix (Fig. 4).

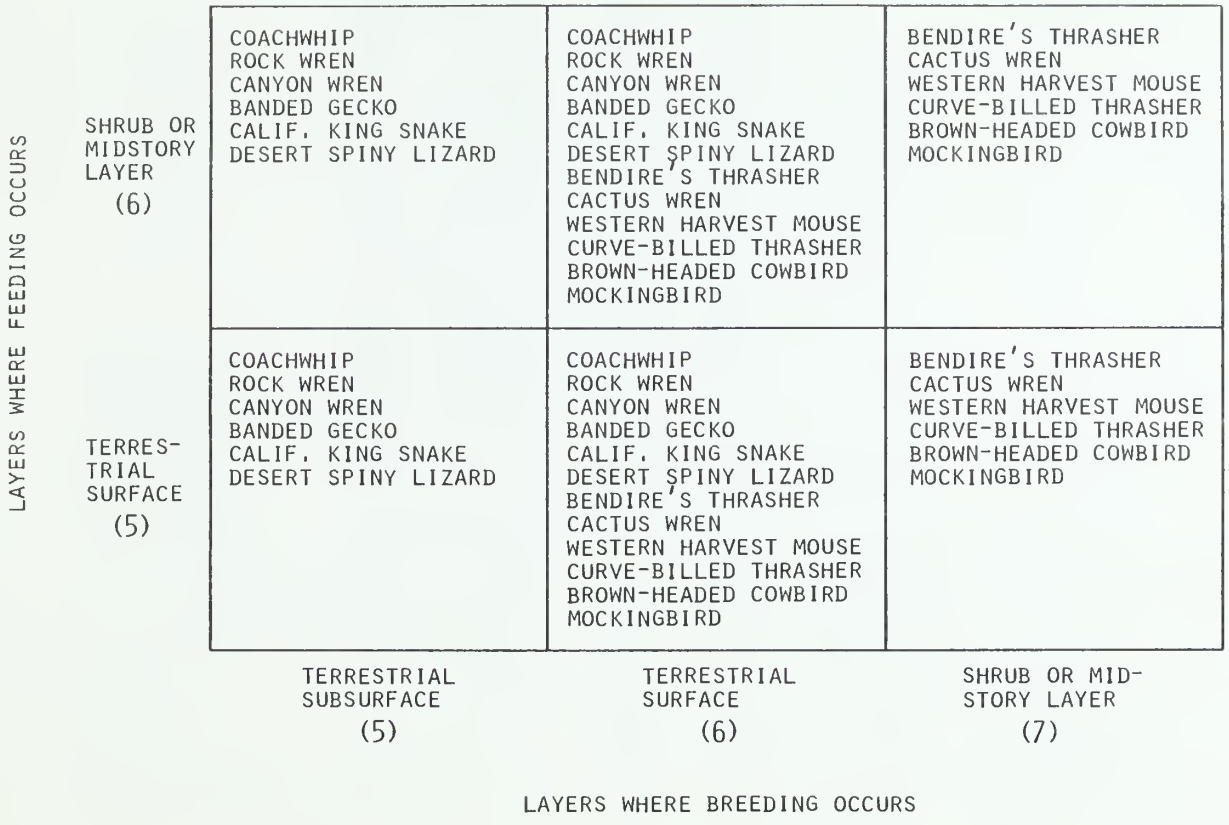


Figure 4. Layers of habitat used in reproductive and foraging activities by twelve secondary consumers in creosote bush-white bursage habitats.

6. Assemble species into wildlife guilds based on their presence in the same guild block or the same series of guild blocks.

The determination of wildlife guilds can be accomplished manually (a rather laborious process) or by using simple computerized sort-and-merge routines. The computer analysis is accomplished in the following way. The layers of habitat where breeding and feeding occur are considered as x,y coordinates that locate the guild blocks in the matrix (in Fig. 4, the x,y coordinates are 6,5 for the guild block defined as breeds on the terrestrial surface, feeds on the terrestrial surface). The x,y coordinates that identify each of the guild blocks used by a species in a cover type are entered into the computer. The software for entering and organizing the data for the sort-and-merge routine is simple and transferable to many types of computers. The sort-and-merge routine groups species that use the same guild block or series of guild blocks. These groups of species represent wildlife guilds (Table 2). Guilds of both primary and secondary consumers are determined for a cover type. Wildlife species with omnivorous food habits will be identified as a member of appropriate guilds of primary and of secondary consumers within a cover type.

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
11	COACHWHIP					5	6									5	6				
	ROCK WREN					5	6									5	6				
	CANYON WREN					5	6									5	6				
	BANDED GECKO					5	6									5	6				
	CALIFORNIA KING SNAKE					5	6									5	6				
	DESERT SPINY LIZARD					5	6									5	6				
12	BENDIRE'S THRASHER					5	6										6	7			
	CACTUS WREN					5	6										6	7			
	WESTERN HARVEST MOUSE					5	6										6	7			
	CURVE-BILLED THRASHER					5	6										6	7			
	BROWN-HEADED COWBIRD					5	6										6	7			
	MOCKINGBIRD					5	6										6	7			

Table 2. Two guilds of secondary consumers occurring in creosote bush-white bursage habitats. The guilds are formed from lists of the wildlife species grouped in the species-habitat matrix of Figure 4.

APPLICATION OF THE COMMUNITY GUILD MODEL IN RESOURCE PLANNING

This section describes both an example demonstrating the usefulness of the Community Guild Model in natural resource management and the explanation of the relationship between wildlife guilds and resource surveys. The example is a familiar problem to land-use managers in arid environments. A user has requested permission to pump water from a certain free-flowing desert stream. The management question is to determine the effects of low, medium, and high rates of water removal on the wildlife community dependent on the associated riparian habitat.

The desert stream in question is a cottonwood-willow riparian habitat in Ecoregion 3222. The wildlife community in this habitat (Fig. 5) includes: (1) a fish community that is dependent on permanent, suitable water in the streambed; (2) amphibians that are dependent on suitable aquatic habitat for a breeding substrate and frequently utilize terrestrial habitats for a feeding substrate; (3) reptiles, birds, and mammals that breed in a variety of terrestrial layers of habitat but forage within the aquatic system; and (4) a variety of vertebrate species that utilize the specialized vegetation occurring within the riparian streamer for foraging and breeding. This specialized vegetation, trees in an otherwise desert scrub community, is dependent either on the presence of free water or on a very high water table.

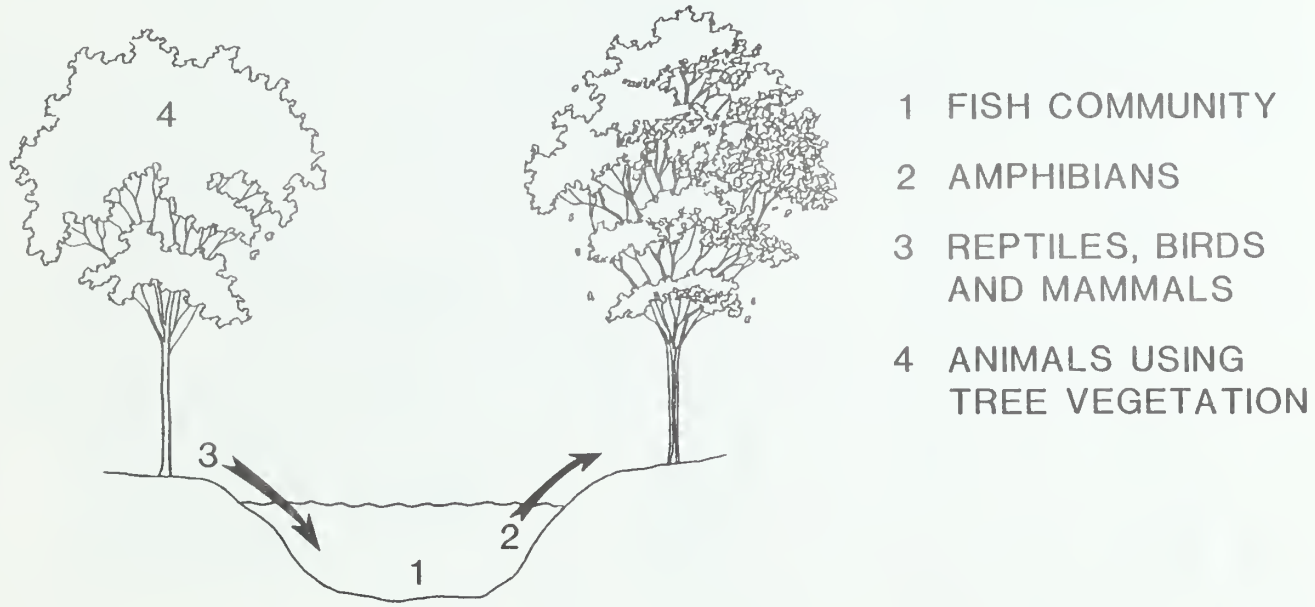


Figure 5. Riparian habitats in desert communities provide unique combinations of habitat layers for the wildlife community.

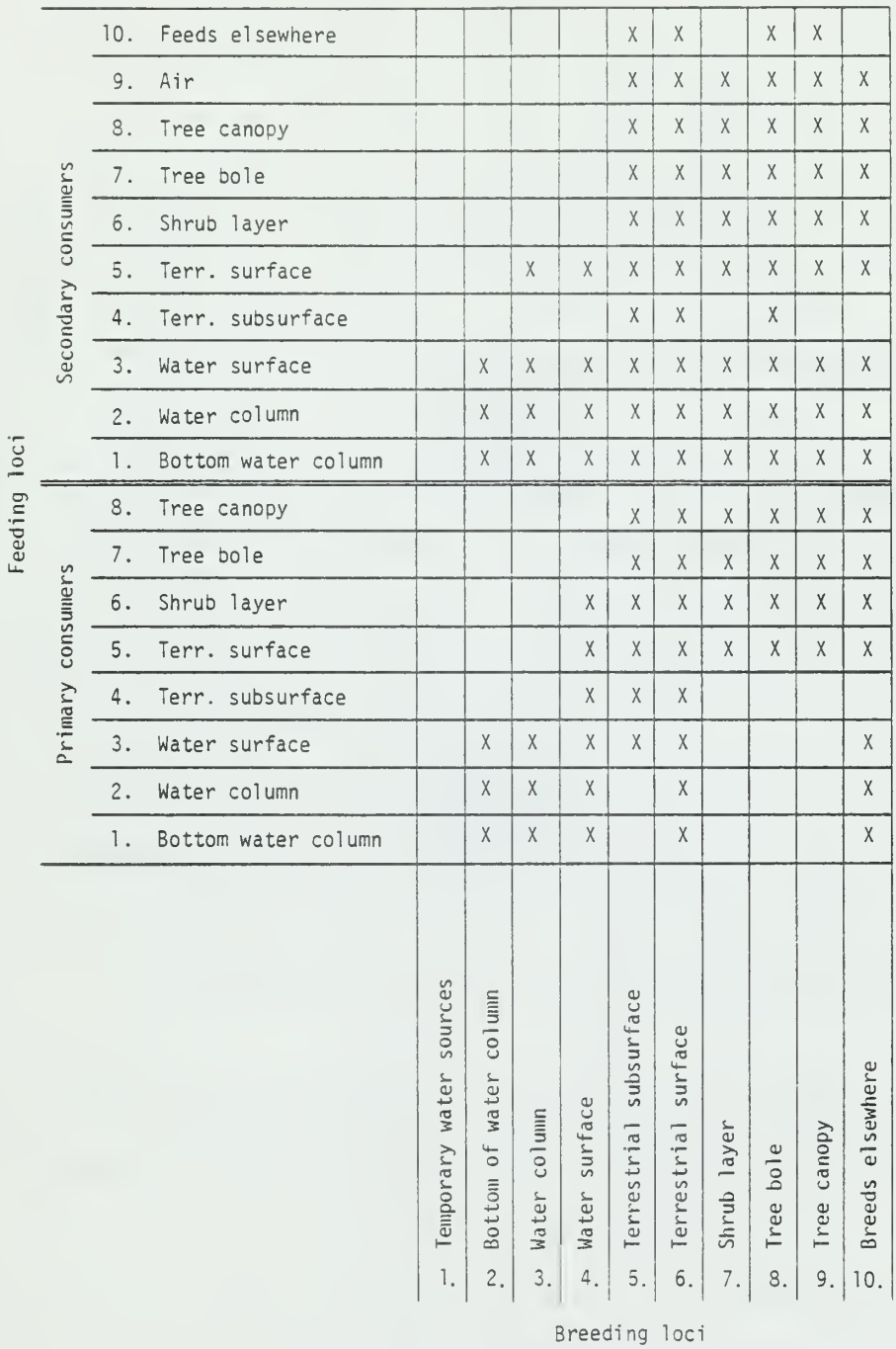


Figure 6. Guild blocks used by wildlife species in the cottonwood-willow riparian type.

One way to represent the complex wildlife community that potentially exists in this riparian habitat is to indicate the guild blocks used by wildlife in the cottonwood-willow riparian cover type (Fig. 6). The effects of dewatering can be related to wildlife guilds and wildlife species because more groups of guild blocks become unavailable to wildlife as dewatering increases in severity. Therefore, the impacts of various levels of water removal on the wildlife community can be predicted.

The impacts of low, medium, and high rates of dewatering are presented below as three management scenarios. Impacts to wildlife guilds can be considered either deleterious or adverse. A deleterious impact to a wildlife guild occurs when all of the guild blocks required by the wildlife guild are removed from the habitat. An adverse impact to a wildlife guild occurs when some of the guild blocks required by the wildlife guild are removed from the habitat. Wildlife species that occupy a single guild block in a single cover type, especially if that cover type is in short supply in the planning unit, should be of special concern to biologists, planners, and managers.

Scenario 1. How would the wildlife community be affected if dewatering of the desert stream occassionally caused the stream to become dry?

The occassional drying of the stream would result in it becoming uninhabitable to fish and other wildlife species totally dependent on the continual presence of suitable water. The guild blocks impacted by this action are highlighted in Figure 7. This impact can be directly translated from guild blocks to wildlife guilds and species because the wildlife guilds

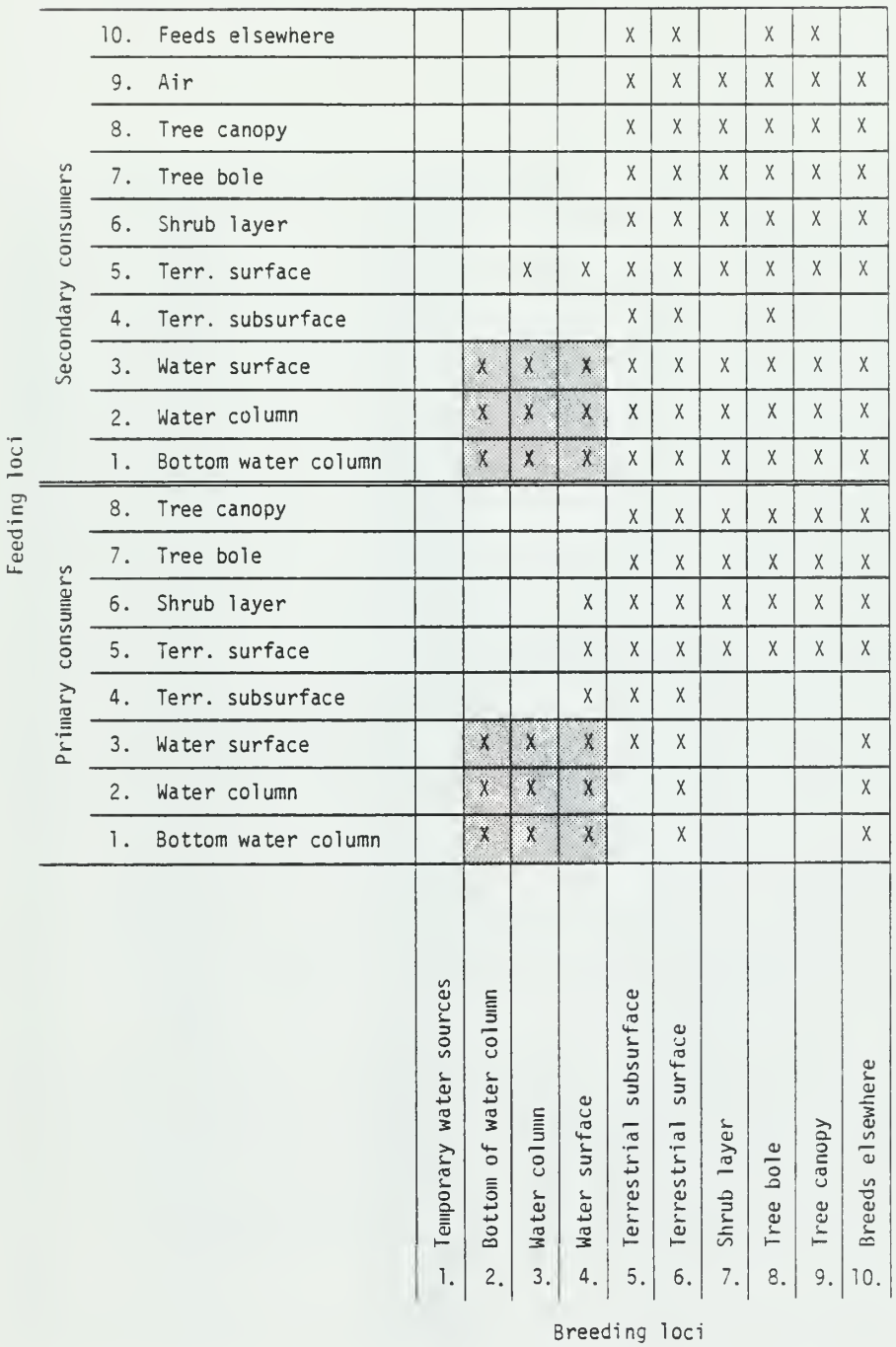


Figure 7. Guild blocks that are highlighted are those impacted by the occasional drying of the free-flowing stream in the cottonwood-willow riparian type.

Table 3. Some guilds of secondary consumers in cottonwood-willow riparian habitats in westcentral Arizona. The five guilds that are highlighted contain fish species that would be deleteriously impacted by the occasional drying of the free-flowing stream.

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
1	MUSKRAT	1	2	3		5									4	5					
2	AMERICAN COOT	1	2	3		5									4						
3	GREAT BLUE HERON	1	2	3		5											6			9	
4	MALLARD	1	2	3		5											6				
5	GREAT EGRET	1	2	3		5												7		9	
	BLACK-CROWNED NIGHT HERON	1	2	3		5												7		9	
	GREEN HERON	1	2	3		5												7		9	
6	CANADA GOOSE	1	2	3		5															10
	AMERICAN BITTERN	1	2	3		5															10
	SNOWY EGRET	1	2	3		5															10
7	LONGFIN DACE	1	2	3									2	3	4						
	RED SHINER	1	2	3									2	3	4						
8	GILA SUCKER	1	2	3									2		4						
9	PIED-BILLED GREBE	1	2	3											4						
10	COMMON MERGANSER	1	2	3												5	6		8		
11	EARED GREBE	1	2	3																	10
12	SPECKLED DACE	1	2										2	3							
	CARP	1	2										2	3							
13	RACCOON	1		3		5	6		8							5	6	7	8		
14	WHITE-FACED IBIS	1		3		5															10
15	YELLOW BULLHEAD	1											2								
	BLACK BULLHEAD	1											2								
	GILA MOUNTAIN-SUCKER	1											2								
16	BLACK-NECKED GARTER SNAKE		2	3		5											6				

Table 3. (continued).

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
17	ROUNDTAIL CHUB		2	3											3	4					
	GREEN SUNFISH		2	3											3	4					
18	SOFT-SHELLED TURTLE		2	3													6				
	YELLOW MUD TURTLE		2	3													6				
	SONORA MUD TURTLE		2	3													6				
19	CHECKERED GARTER SNAKE		2			5											6				
20	COYOTE			3	4	5	6									5	6				
21	STRIPED SKUNK			3	4	5										5	6				
	HOG-NOSED SKUNK			3	4	5										5	6				
22	BLACK BEAR			3	4	5															10
	BADGER			3	4	5															10
23	COOPER'S HAWK			3		5	6	7	8	9								7		9	
24	COMMON RAVEN			3		5	6	7	8								6		8	9	
25	BLACK HAWK			3		5	6	7	8											9	
26	RED-WINGED BLACKBIRD			3		5	6			9							6	7			
27	BREWER'S BLACKBIRD			3		5	6			9											10
	YELLOW-HEADED BLACKBIRD			3		5	6			9											10
	LONG-BILLED MARSH WREN			3		5	6			9											10
28	BOBCAT			3		5	6									5	6				
29	GREAT-TAILED GRACKLE			3		5	6										6	7		9	
30	LEAST BITTERN			3		5	6														10
31	BLACK PHOEBE			3		5				9							6				
32	LEOPARD FROG			3		5									4						
33	GRAY FOX			3		5										5	6				
	WESTERN SPOTTED SKUNK			3		5										5	6				
34	CINNAMON TEAL			3		5											6				

are based on the way wildlife species use the available guild blocks in a habitat cover type. The wildlife guilds of some secondary consumers potentially occurring in the cottonwood-willow riparian habitat are listed in Table 3. The five guilds of secondary consumers deleteriously impacted by a low level of dewatering are also highlighted in this table. Other consumers feeding on fish will also be adversely impacted by this environmental action although these species are not addressed here.

Scenario 2. How would the wildlife community be affected if dewatering of the desert stream caused the stream to be dry most of the time.

A usually dry stream bed would result in the riparian community becoming unsuitable habitat for species that feed in the aquatic habitat and species that breed in the aquatic habitat and feed either in water or in terrestrial habitat layers (Fig. 8). Fourteen guilds of secondary consumers will be deleteriously affected by this level of dewatering (Table 4) and 24 guilds of secondary consumers will be adversely affected.

Food chains outside the aquatic system will also be impacted by changes in the food base in riparian areas, but the level of impact is not easily determined.

Scenario 3. How would the wildlife community be affected if dewatering of the desert stream removed all water from the stream and lowered the water table to the degree that it no longer supported trees?

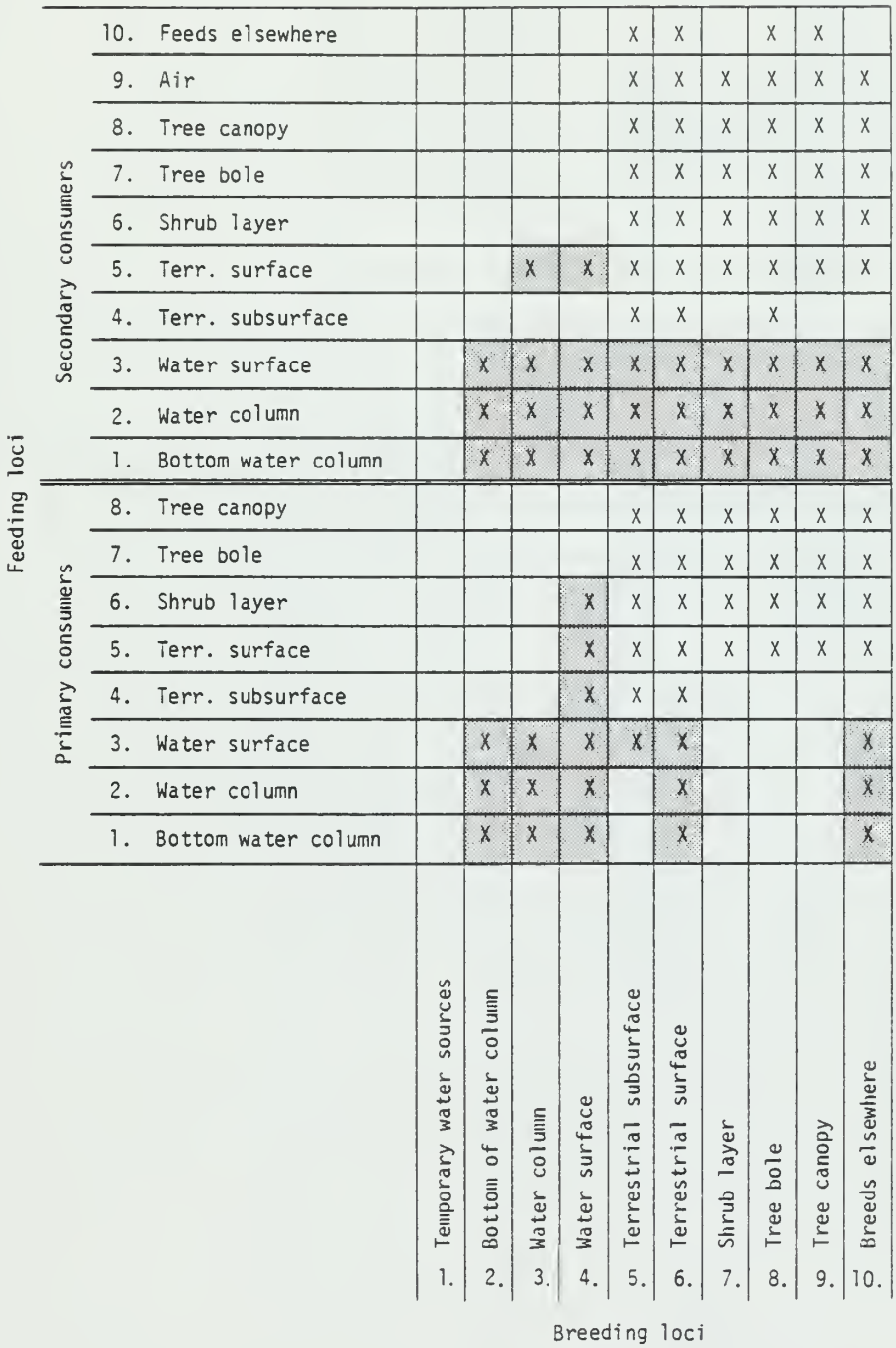


Figure 8. Guild blocks that are highlighted are those impacted because free-flowing water is not usually present in the streambed of this cottonwood-willow habitat type.

Table 4. Effects of different levels of dewatering on secondary consumer guilds in cottonwood-willow riparian habitats.

Impacted guilds	Impacted system or layer of habitat		
	Aquatic	Tree bole	Overstory
Deleterious impacts			
Secondary consumers [a]	4, 9-14, 17, 19-20, 34, 38 84-85	50, 61, 66, 71, 97, 105	27, 54, 108
Totals	14 guilds (27 species)	6 guilds (11 species)	3 guilds (4 species)
Adverse impacts			
Secondary consumers [a]	3, 5-8, 15-16, 18, 21-33, 35-37	2, 12, 15, 25-27, 39, 43-49, 51-57, 63, 69, 79, 81, 90, 93-96, 98-99, 101, 107	2, 5, 7, 15,25-26, 31, 39, 43-53, 55, 57-67, 69-70, 74, 81-82, 88, 90, 93-98, 100
Totals	24 guilds (34 species)	34 guilds (66 species)	45 guilds (87 species)

[a]See Table 3 for a list of species in some of the identified secondary consumer guilds.

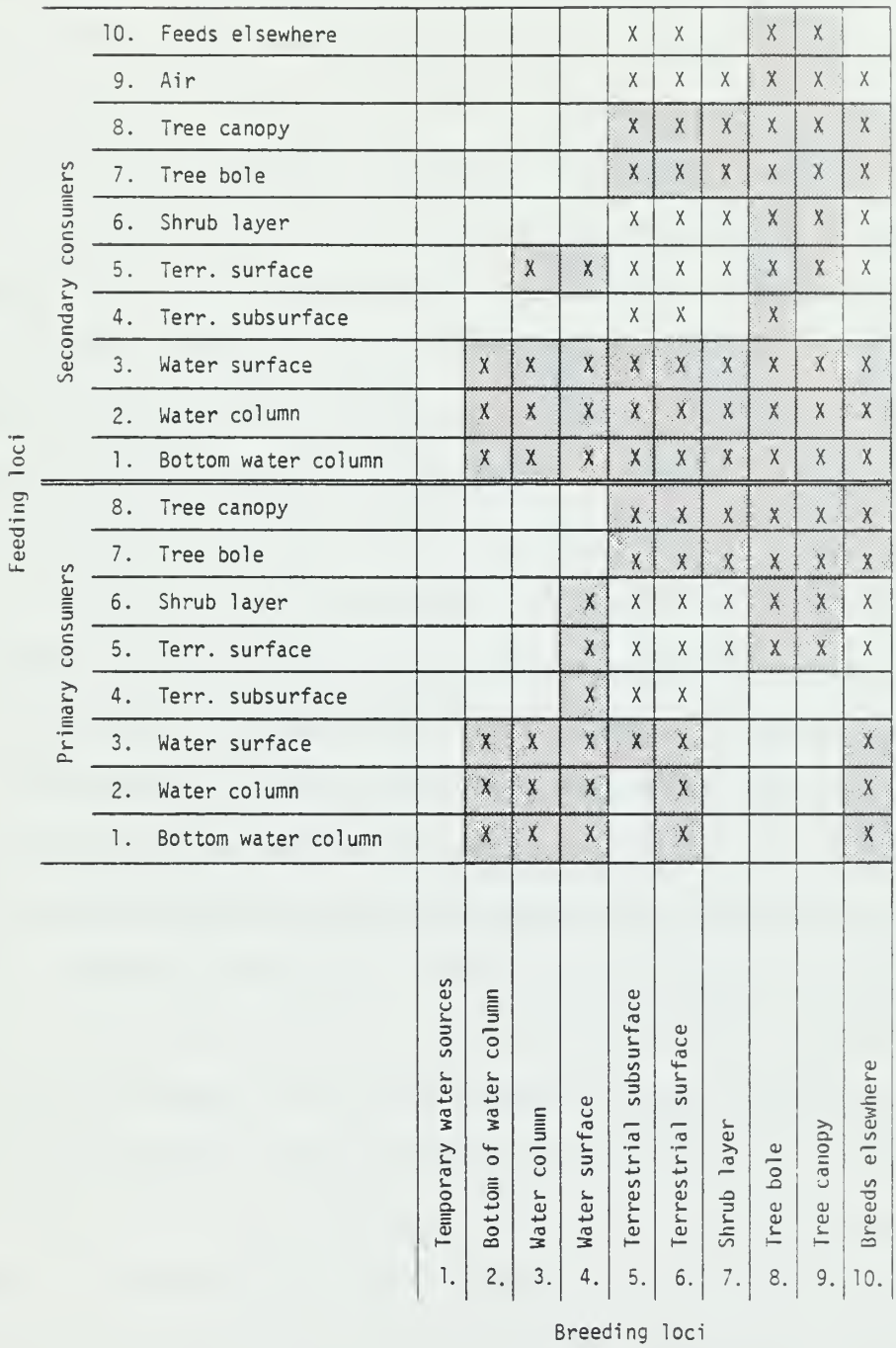


Figure 9. Guild blocks that are highlighted are those impacted by the destruction of tree vegetation because of the extensive reduction of the water table in the cottonwood-willow habitat.

Many wildlife guilds and species occur in riparian habitats in the southwestern desert because the structure of the vegetation community is unique within the Ecoregion. The guild blocks impacted by extensive dewatering are highlighted in Figure 9. Nine guilds of secondary consumers will be deleteriously affected by the loss of trees in this habitat and 53 guilds will be adversely affected (Table 4). The extensive dewatering of the cottonwood-willow riparian habitat would effectively reduce the riparian treeland community to a desert scrub community, resulting in a severe negative impact on the wildlife resources of the Ecoregion.

The above example emphasizes that if proposed land-use changes can be associated with layers of habitat that the impacts of those land-use changes on the wildlife community can be predicted. The predictive capability occurs because wildlife species are associated with layers of habitat in the guilding process. Layers of habitat provide a convenient common denominator for considering both wildlife species and other land management activities.

The relationship between wildlife guilds and resource surveys is complementary and not competitive. The community guild model provides a mechanism for ordering specialized information about individual species into an interpretable framework. It is often quite difficult, without such a framework, to aggregate diverse and specialized information about individual species into an integrated system pertinent to the total wildlife community. An especially useful feature of the guild model is that the species-habitat matrix can be

used to produce wildlife guilds whether very extensive or rather fragmentary information is available about a species.

There are obvious costs associated with the development of wildlife guilds for an ecoregion. The determination of cover types in the ecoregion, lists of species occurring in those cover types, and layers of habitat used by wildlife species for foraging and reproductive activities require the time of qualified and professional biologists. About four work months were required to develop the database used in the production of wildlife guilds in the Hualapai-Aquarius planning units. This time could be reduced somewhat because it is only necessary to identify the layers of habitat where nesting, hatching, or birthing occur (x-axis of the species-habitat matrix) and the layers of habitat where foraging occurs (y-axis of the matrix). Additional information about actual foods eaten in layers of habitat and actual breeding substrates in layers of habitat (levels of detail not needed in this guilding process) were obtained and coded in the Hualapai-Aquarius study. Data entry for an ecoregion-wide database might take an additional work month. The software programs for organizing and manipulating the coded data are written and should be transferable and applicable to many machines. The tables of wildlife guilds produced for each cover type are machine generated.

The costs of developing wildlife guilds seem justifiable because the product from the guilding exercise is a planning tool that complements information obtained in field surveys. The guilding exercise provides a statement of the structure of the potential wildlife community occurring in an area. It also provides a statement of how proposed land-use changes will impact the

wildlife community. The community guild model almost certainly provides this information more cheaply than does inventory data. In addition, the guild analysis aids the design of inventory assessments because the emphasis on layers of habitat provides a stratification tool for designing field surveys thereby improving their cost effectiveness. Field surveys can be designed to look for species that have been shown in the guild analysis to have specialized dependencies on the structure of the habitat. The field survey is especially warranted if that habitat structure is in short supply. Only inventory data can provide the detailed information about individual wildlife species to determine if a species needs special management considerations. Field surveys can also be designed to verify the structure of the wildlife community that the guild model predicts present in a habitat.

The use of the guild and layers of habitat models as evaluation tools is of additional advantage to the manager because their use allows: (1) the inventory of the quantity of wildlife habitat in a planning unit; (2) the evaluation of the relative quality of cover types and land areas for the total wildlife community; (3) an assessment of trends in the quantity and quality of wildlife habitat in a planning unit; (4) the provision of a common denominator so that wildlife habitat and other land resources can be considered together in a management plan; (5) the prediction of the effect of proposed land-use changes on the total wildlife community; and (6) the screening and selection of particular land-use scenarios that will be least detrimental to the total wildlife community.

METHODS

The methodology for developing guilds of wildlife species, as well as concepts basic to the guilding technology, have evolved from methods and thoughts described in a paper by Short and Burnham (1982). The basic concept remains, however, that the niche of a wildlife species is a very complex association of physiological and environmental parameters that is difficult to describe and quantify. I have assumed, however, that even incompletely described niches of species can be correctly positioned within the volume of habitat that occurs within a cover type. I positioned species within the volume of habitat for this analysis in a way similar to that done in the study by Short and Burnham (1982). Two important niche parameters, food sources and breeding substrates, were selected on the basis of their obvious importance and the likelihood that useful descriptive information would be available. These two parameters became the coordinates of a simple two-dimensional species-habitat matrix with food sources representing the y-axis and breeding substrates the x-axis. The y-axis of the matrix was divided so that primary consumer food habits could be separated from secondary consumer food habits. The primary and secondary portion of the y-axis, as well as the x-axis, of the matrix were subdivided to indicate the layers of habitat present in a cover type. Numerous authors have indicated the importance of layers of habitat or

strata to the wildlife community. The appearance of the species-habitat matrix is indicated in Figs. 11-16, in the Results section.

Three hundred and ninety-three wildlife species were identified as occurring within the diverse cover types of the upper and lower Sonoran desert habitats of the Hualapai-Aquarius planning units in westcentral Arizona (Appendix I). The approximate location of the 1.48 million acre planning units, which contains 14 different habitat types, is indicated in Fig. 10. Wildlife species were associated with the different habitat types on the basis of the professional experience and knowledge of BLM biologists and an extensive review of published range maps. The distribution of wildlife species by habitat cover type is listed in Appendix II. The data base driving the guilding analysis was developed by identifying the layer or layers of habitat used for foraging activities and the layer or layers of habitat supplying breeding substrates for each wildlife species in each cover type. Numeric x-y coordinate values, identifying the layers of habitat used for reproductive activities (x-axis) and the layers of habitat used for foraging activities (y-axis) were developed for each species. These numerical values describe the position occupied by a species within the species-habitat matrix. I have assumed that the position a species occupies in the species-habitat matrix, based on habitat requirements for food sources and breeding substrates, will generally represent the position occupied by the species within the habitat volume of a cover type.

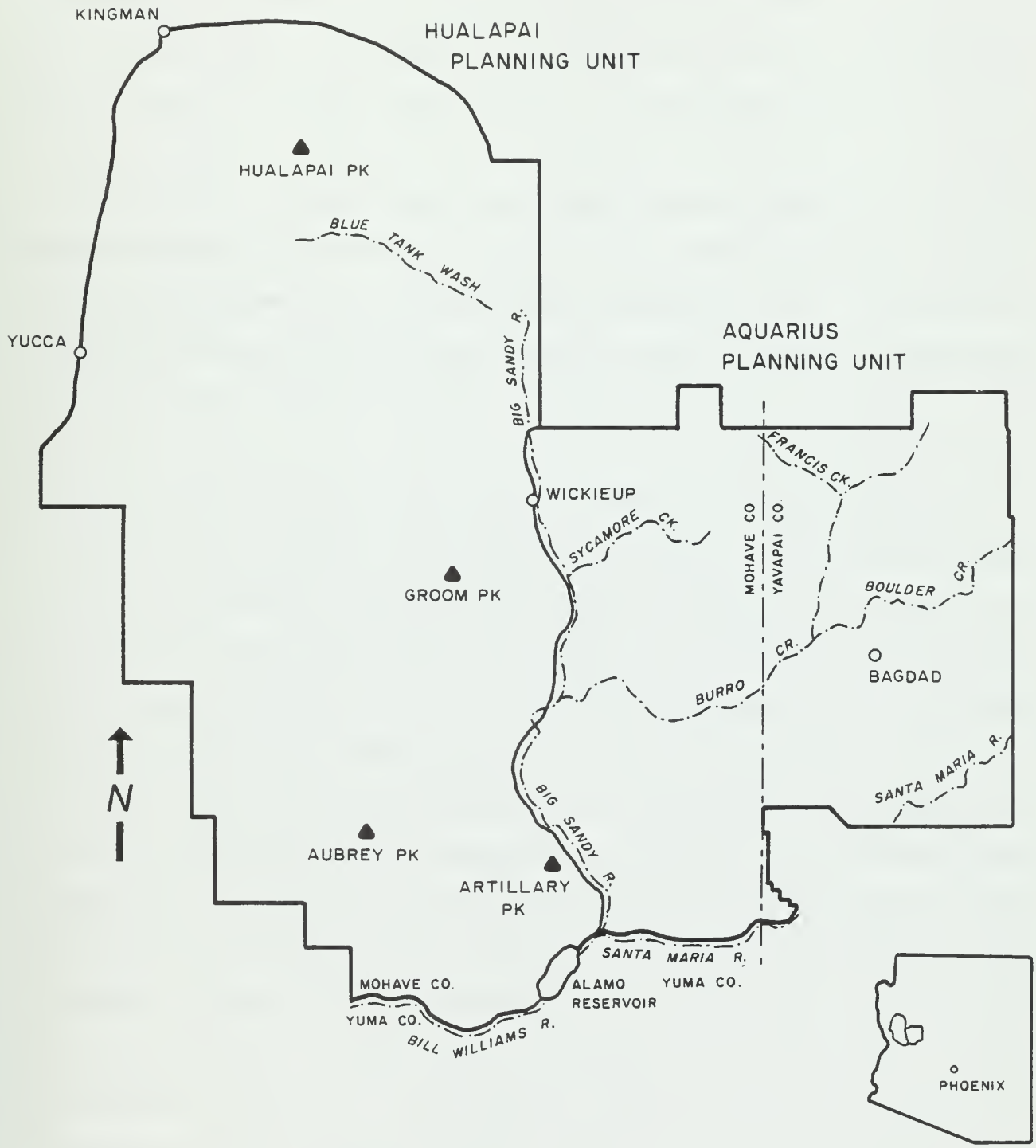


Figure 10. The Hualapai-Aquarius planning area.

The blocks within the species-habitat matrix, formed by the intersection of the different layers of habitat where food sources occur (layers along the y-axis) and the different layers of habitat where breeding substrates occur (layers along the x-axis), are called guild blocks. The x-y coordinate values identify guild blocks within the species-habitat matrix. The relative complexity of the different types of habitat within the Hualapai-Aquarius planning units is illustrated by habitat matrices for the different cover types that show the guild blocks used by wildlife species in each habitat type (Figs. 11-16).

The numeric data (x-y coordinate values) for each species in each habitat type where that species occurs were structured into computerized data files. Simple and portable computer programs (FORTRAN) were written by Dr. K. P. Burnham to check the basic data, compute summary statistics, and print various summaries. These summaries included lists of species by habitat types, the list of x-y coordinate values for each species which identifies the guild blocks occupied by each species in each habitat type, and, finally, with the use of a merge and sort routine, the aggregation of species into groups that use the same combination of guild blocks within each habitat type. These groups of species are called wildlife guilds. A vertebrate wildlife species may occur in guilds of both primary consuming species and secondary consuming species, if the species is omnivorous in its food habits. A species may use a different guild block as a primary consumer than as a secondary consumer and may share guild partners as a primary consumer that are different from the guild partners present in the secondary consumer guild. Guilds of primary

consumers in the different habitat types are listed in Tables 5, 8, 11, 14, 17, 20, 23, 26, 29, 32, 35, 38, 41, and 44; guilds of secondary consumers are listed in Tables 6, 9, 12, 15, 18, 21, 24, 27, 30, 33, 36, 39, 42, and 45.

The wildlife guilds produced in this report are rather general in that a seemingly wide variety of animals can occur within the same guild. This generality is acceptable and useful, however, because each member of the guild has a major dependency on the structure of habitat and may be similarly affected by impact to the habitat layers important to the guild.

RESULTS

HABITAT STRUCTURE AND THE WILDLIFE COMMUNITY

The importance of the structure of habitats to the wildlife community can be illustrated with habitat matrices developed for the different types of habitat present in the westcentral Arizona study area. Fourteen habitat matrices were developed and six are illustrated in Figs. 11-16. The six illustrations represent the different types of habitat structure present in the Hualapai-Aquarius planning unit.

Guild blocks can be thought of as a first approximation of the ways in which wildlife species utilize a type of habitat. For example, there are a limited number of ways in which wildlife species can use desert grassland habitats (Fig. 11). A species can breed in a burrow (subsurface layer or stratum) and feed within burrows, on the surface, in the air, or some combination of these alternatives. Likewise, a species can breed on the terrestrial surface and feed in the subsurface layer, on the terrestrial surface, in the air, or some combination of these alternatives. Migrant species that breed elsewhere but use the desert grasslands as feeding habitat, at least part of

Figure 11. Use of guild blocks by wildlife species in desert grassland habitats.

the year, can also feed in the subsurface, on the terrestrial surface, in the air, or some combination of these alternatives. An additional guild block is occupied by Couch's spadefoot toad in some low elevation desert grassland habitats. This toad can be a localized breeder in temporary pools of water following heavy rains during summer and is a secondary consumer on the terrestrial surface (Table 15).

The 10 guild blocks marked with an x in the upper half of the habitat matrix in Fig. 11 represent the only guild blocks used by vertebrate wildlife species on desert grassland habitats that provide only a surface layer of vegetative cover. Secondary consumers, because of their aerial feeding strategy, generally use more guild blocks than do primary consumers.

Lentic habitats (Fig. 12) in the study area are best represented by Alamo Lake (see map in Fig. 10). Obviously, an entirely different group of guild blocks are used by wildlife species in this habitat. The vertebrate species include fish that breed and feed within the lake, amphibians that breed in the aquatic system and migrate to use surrounding land areas as feeding habitats, and reptilian, avian, and mammalian species that breed elsewhere (either on adjacent or distant lands) and feed within or above the aquatic system (Tables 26 and 27).

The importance of habitat structure to the wildlife community is emphasized by the number of guild blocks available to wildlife in creosote bush-white bursage habitat (Fig. 13). Except for the guild block occupied by Couch's spadefoot toad (breeds in temporary waters and feeds on the terrestrial

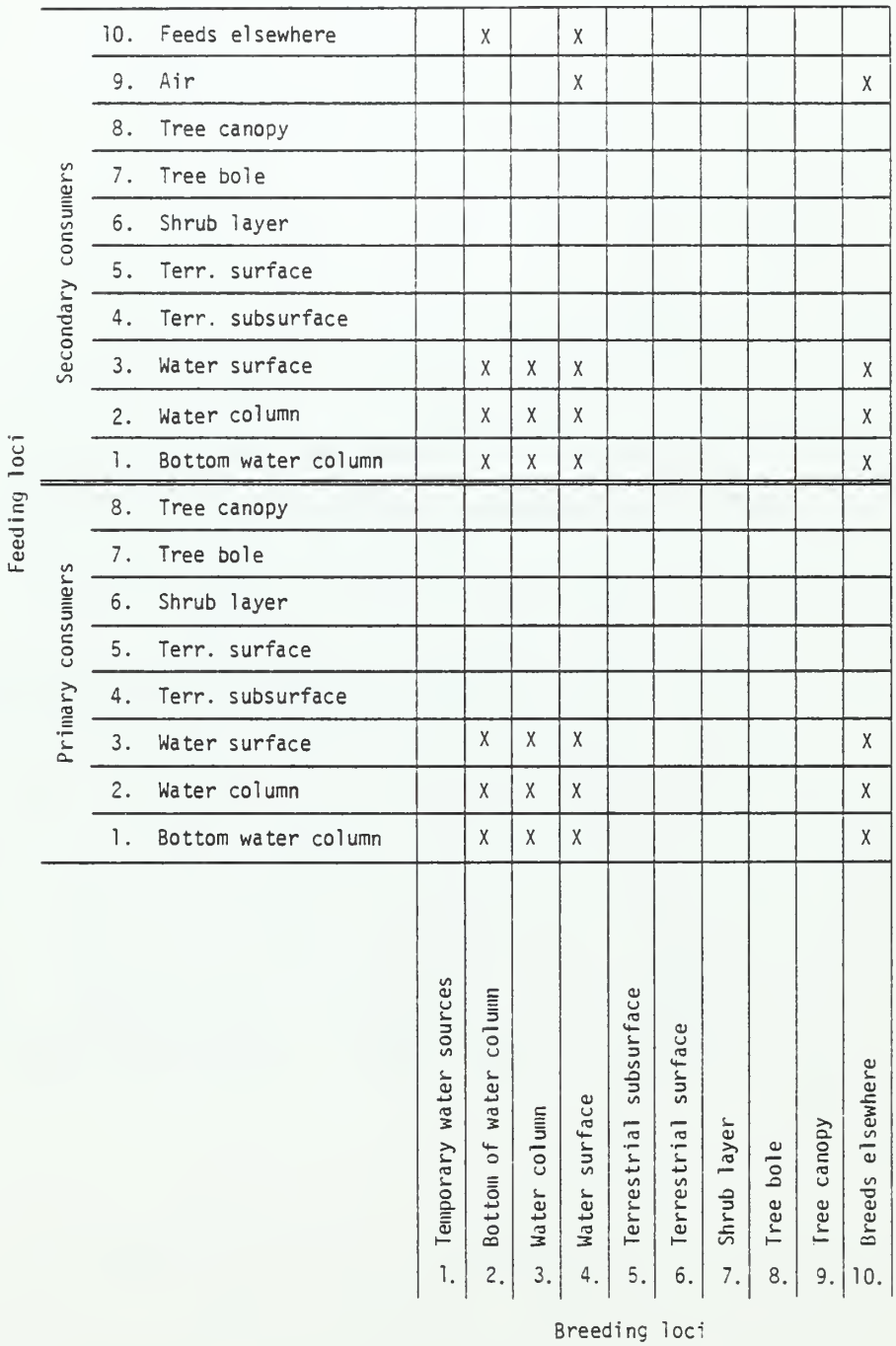


Figure 12. Use of guild blocks by wildlife species in lentic habitats.

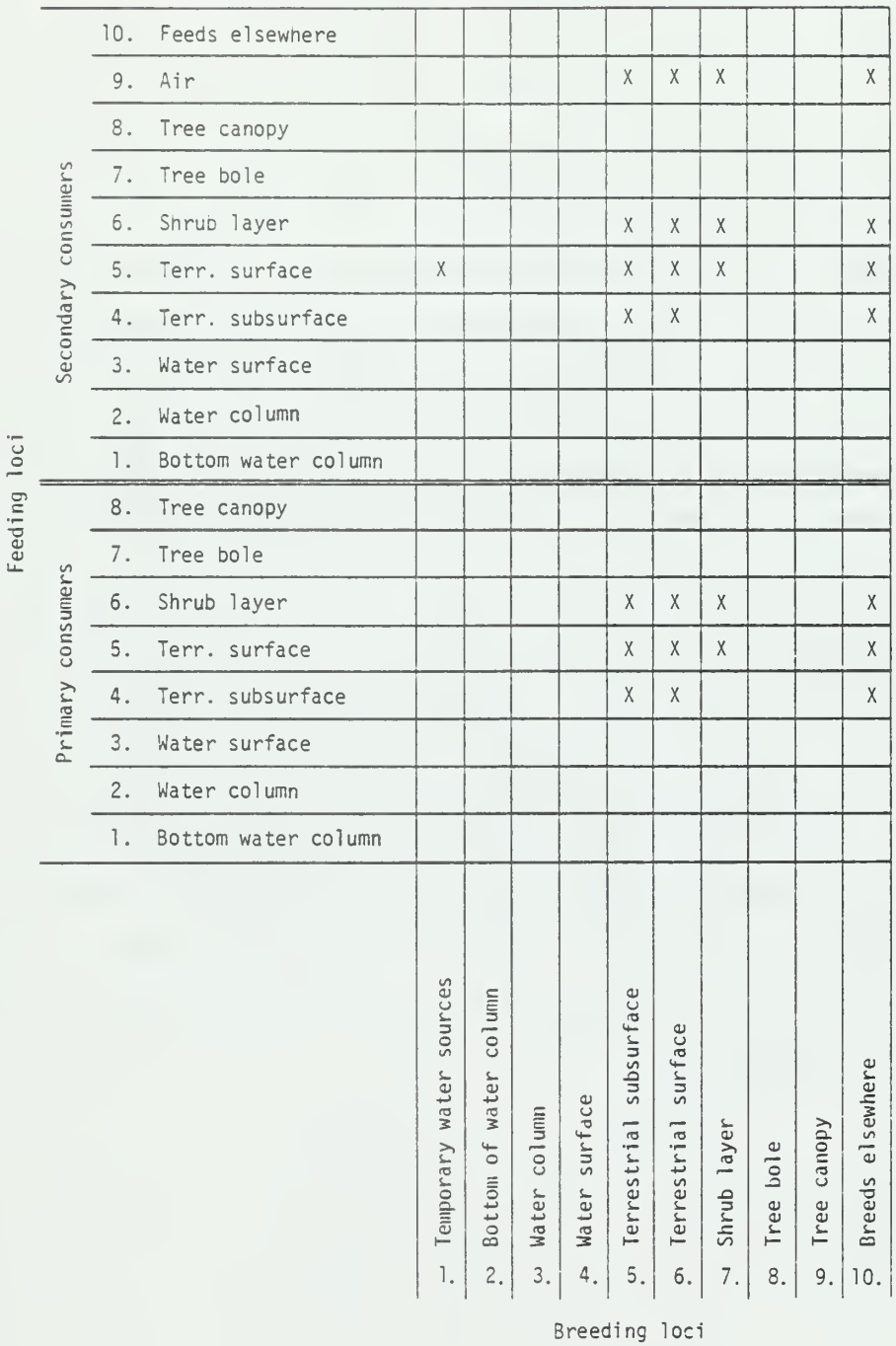


Figure 13. Use of guild blocks by wildlife species in creosote bush - white bursage habitats.

surface), the guild blocks for this habitat type also characterize the structure of chaparral, joshua tree-juniper, joshua tree-creosote bush, and juniper-mixed shrub communities in the study area. The listing of guild blocks thus describes the similarity in the general structure of these habitats. The wildlife guilds potentially present in these cover types are reasonably similar, because guilds are based on the ways that wildlife species use guild blocks. Presumably, wildlife species are usually more dependent on the structure of habitat than on the specific plant species present. Any action that impacts the same layer of habitat in all of these cover types will presumably impact the same portion of the wildlife community in each type.

The saguaro cactus in saguaro-palo verde or desertscrub habitats acts as a tree without a canopy because it provides a bole suitable for excavators and cavity users. This plant community, which would otherwise be similar in structure to creosote bush-white bursage habitats, has an additional layer of habitat because of the presence of this giant cactus (Fig. 14). The structure of this community is not unlike that of many pinyon-juniper woodlands, where there is a tree bole of suitable dimensions for excavators and cavity users and a midstory canopy.

Ponderosa pine habitats in the higher mountain elevations in the study area can provide five layers of habitat (subsurface, surface, shrub or midstory, tree bole, and tree canopy layers) (Fig. 15). This habitat matrix is similar to that for ponderosa pine-mixed conifer habitat. Riparian habitats, like mature cottonwood-willow, mesquite-saltcedar, and mixed broadleaf riparian cover types can potentially provide layers of habitat associated with both

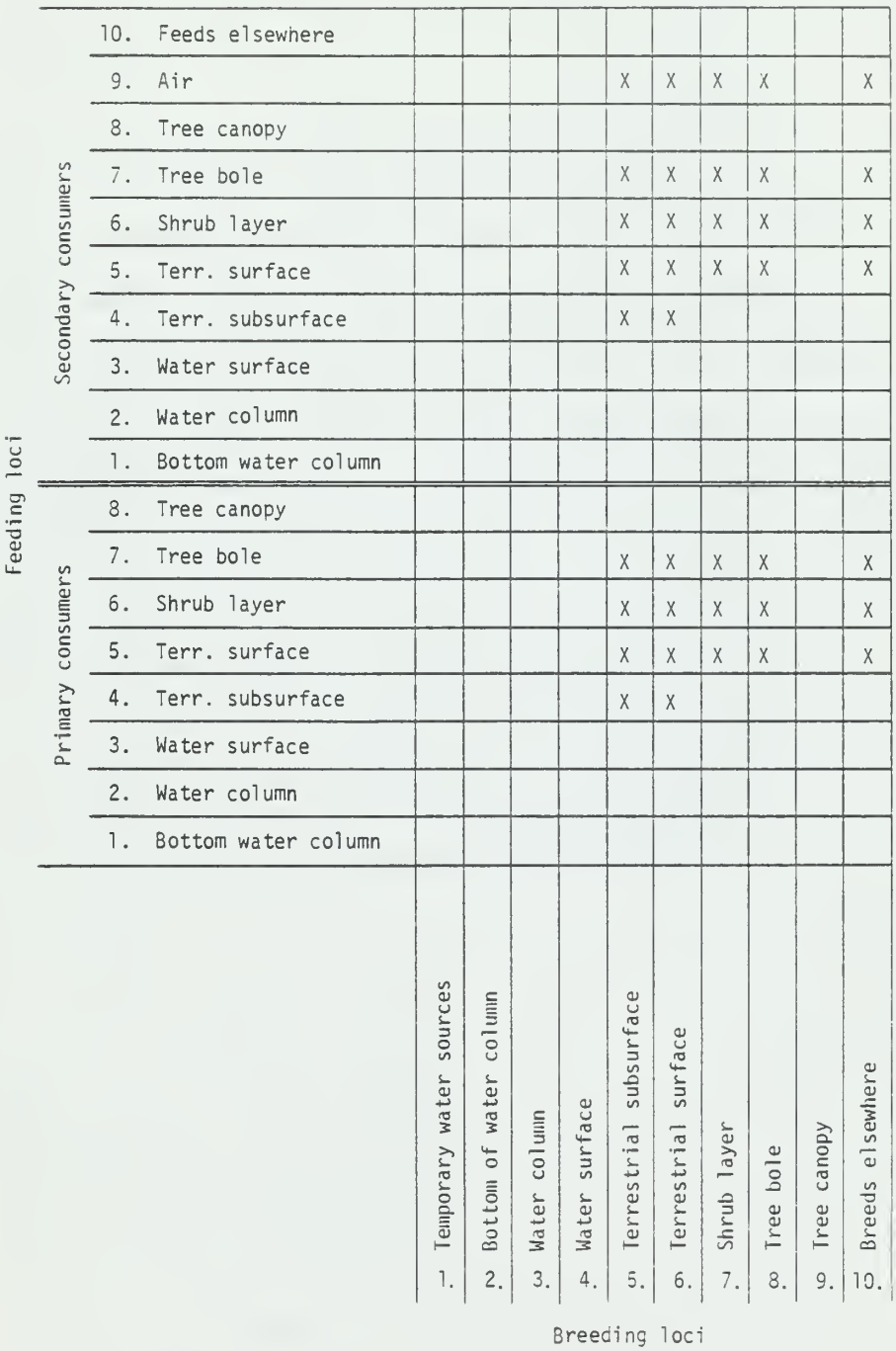


Figure 14. Use of guild blocks by wildlife species in saguaro - palo verde habitats.

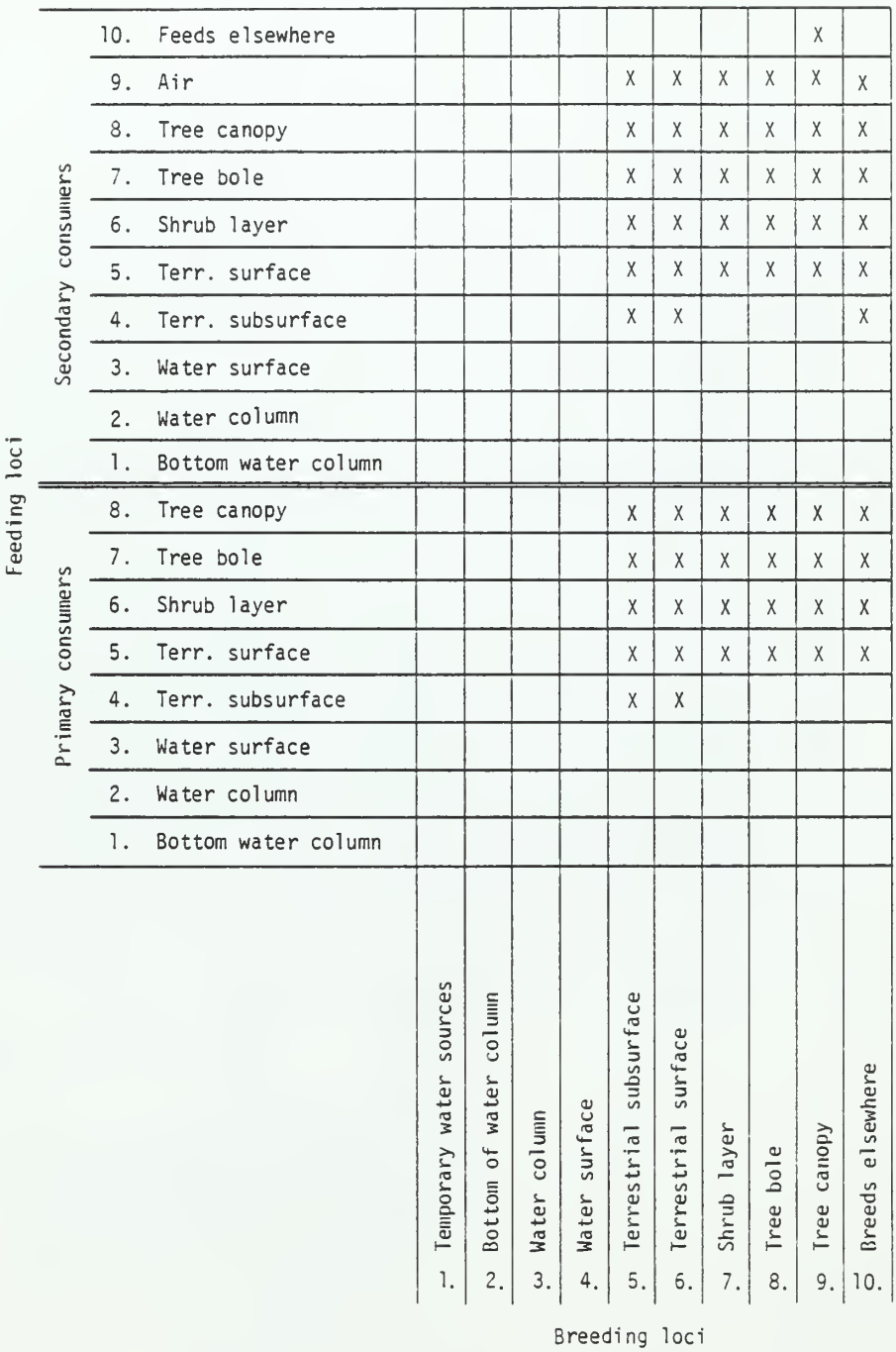


Figure 15. Use of guild blocks by wildlife species in ponderosa pine habitats.

aquatic and terrestrial treeland systems. A large number of guild blocks are potentially used by vertebrate wildlife species in the cottonwood-willow riparian type (Fig. 16).

The number of wildlife guilds potentially occurring within the different cover types in the Sonoran desert is highly significantly related to the number of habitat layers and guild blocks present in these communities. This relationship is developed in detail below (Fig. 17). The number of bird species and guilds containing birds is also significantly related to the number of guild blocks present in these cover types (Figs. 18 and 19, below).

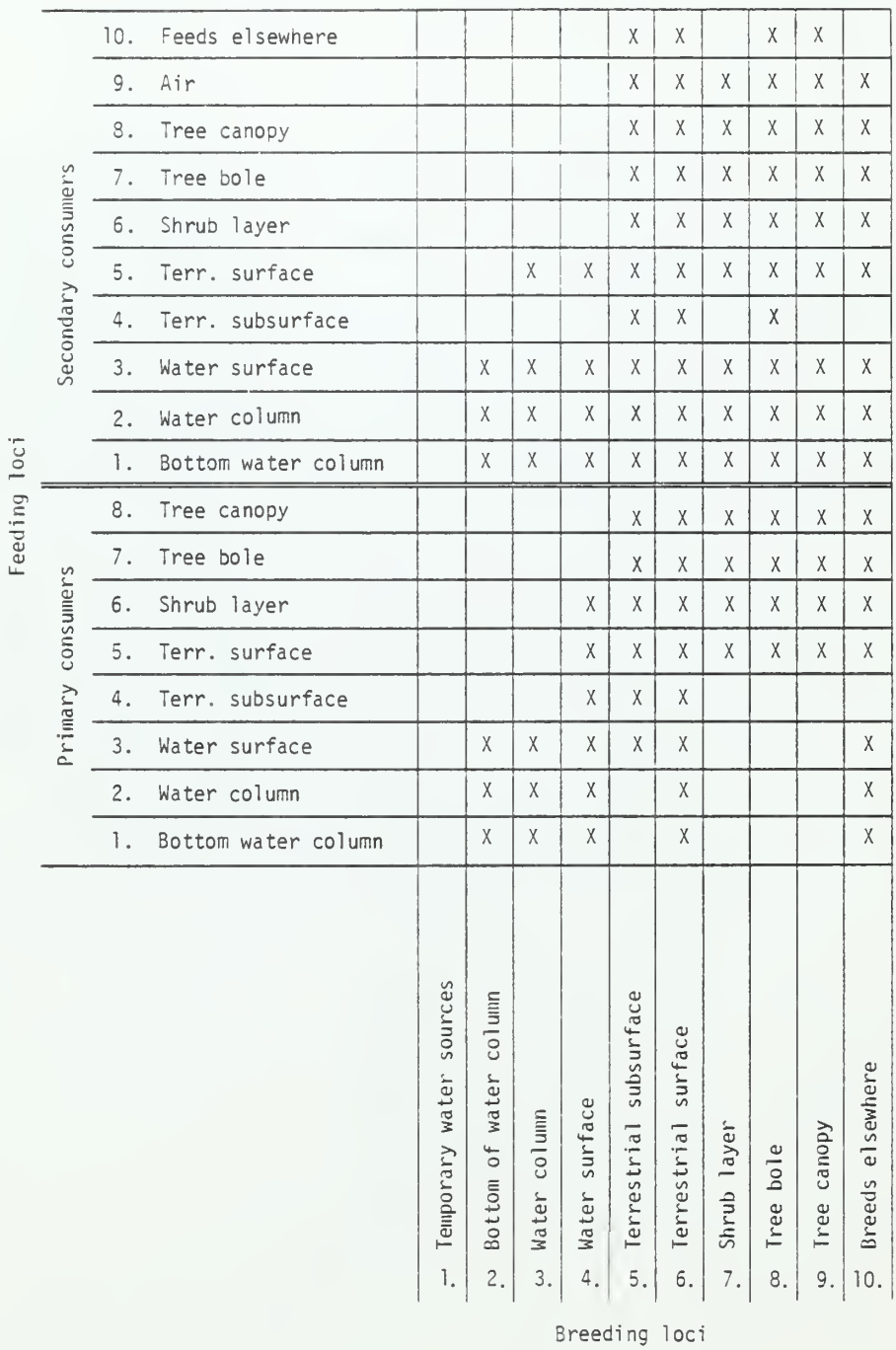


Figure 16. Use of guild blocks by wildlife species in mixed broad leaf riparian habitats.

PREDICTING IMPACTS OF LAND-USE CHANGE ON WILDLIFE GUILDS

Wildlife guilds are groups of species that share the way they utilize habitats; i.e., they use the same guild blocks for their feeding and breeding activities. Therefore, guilds are groups of species whose niches occur in the same volumes of space within a habitat type. These groups of species should react similarly to actions that affect that volume of space.

Wildlife guilds are developed from the guild blocks that wildlife species occupy within a species-habitat matrix. A computerized merge-sort routine groups species that occupy the same combination of guild blocks into wildlife guilds. Guilds of primary consumers are kept separate from guilds of secondary consumers because the y-axis of the habitat matrix is divided so that the guild blocks occupied by primary consumers are different from those occupied by secondary consumers. Guilds of primary and of secondary consumers were developed in this manner for the 14 habitat types identified for the Hualapai-Aquarius planning units. The guilds of primary consumers are listed in Tables 5, 8, 11, 14, 17, 20, 23, 26, 29, 32, 35, 38, 41, and 44; the guilds of secondary consumers are listed in Tables 6, 9, 12, 15, 18, 21, 24, 27, 30, 33, 36, 39, 42, and 45. The breeding and feeding loci identified in the tables are those along the x and y axes in the habitat matrices (Figs. 11-16).

The following discussion includes a brief summary about each of the 14 habitat types, describing the cover type, its distribution and extent within the Hualapai-Aquarius planning units, and the guilds of wildlife species that would be <u>deleteriously</u> or <u>adversely</u> affected by changes in the structure of

the layers of habitat present. A deleterious effect occurs when a layer of habitat is impacted that provides the only loci of breeding substrates or food sources for a guild within a habitat. Thus, the change in the structure of that habitat layer may make the habitat uninhabitable for that guild of species. Many other species will be adversely affected by an impact to a layer of habitat. An adverse effect occurs when a layer of habitat is impacted that is one of the two or more layers providing breeding substrates or food sources important to a guild within a habitat. Thus, the change in the structure of that habitat layer may reduce the carrying capacity of that habitat for a particular guild and its included species but need not result in the extirpation of that guild. The listing of guilds affected by a variety of proposed land-use changes in each of the 14 habitat types is included in Tables 7, 10, 13, 16, 19, 22, 25, 28, 31, 34, 37, 40, 43, and 46. The impacts to wildlife guilds or populations of species can only be interpreted in these analyses in terms of: (1) the population is not likely to be affected; (2) the population will likely be reduced; (3) the population will likely be increased; or (4) the population will likely be extirpated in the area where changes occur.

The following discussion identifies wildlife guilds that would be impacted by changes in the structure of habitats. Those guilds in each habitat type that would be deleteriously impacted by a proposed habitat change are the guilds and species that should be of special concern to managers. Those species may be in jeopardy if the abundance of particular layers of habitat is uncommon or rare within a bounded area like the Hualapai-Aquarius planning unit.

Chaparral Habitat

Chaparral occurs on lands mapped by Kuchler (1964) as potential natural vegetation type (PNVT) 23 (juniper-pinyon woodland) in the Hualapai mountains and as PNVT 58 (grama-tobosa-shrubsteppe) in the northeastern portion of the planning units. The Environmental Impact Statement (EIS) for the Hualapai-Aquarius planning units (U.S. Bureau of Land Management 1980) suggests that the chaparral community occupies less than 9% of the planning units. Important plant species include manzanita (*Arctostaphylos pringlei*), shrub live oak (*Quercus turbinella*), skunk bush (*Rhus trilobata*), buckbush (*Ceanothus* sp.) and sugar sumac (*Rhus ovata*) (Millsap 1981). Jones (1981) considered the dense, closed chaparral community at higher elevations as biologically different from the more open community at lower elevations. This variation in community structure is treated as part of a gradient in the present analysis because the same three layers of habitat are present in all chaparral habitats, even though the density of the shrub canopy differs. The chaparral community provides subsurface, surface or understory, and shrub or midstory layers. No attempt has been made in the present analysis to distinguish between the use of open and closed canopies of chaparral by vertebrate species. One hundred and ninety-three vertebrate species potentially use chaparral as habitat (Appendix II); these species are arrayed into 19 guilds of primary consumers (Table 5) and 28 guilds of secondary consumers (Table 6).

Heavy grazing or other activities that reduce surface vegetation in chaparral habitats will deleteriously affect food sources and breeding substrates of seven guilds of primary consumers and eight guilds of secondary consumers (Table 7). Ten other guilds of primary consumers will be adversely impacted. Other guilds of secondary consumers will also be adversely affected if limited surface vegetation reduces the biomass of primary consumers, thereby impacting the food chains of secondary consumers. A conservative grazing management policy will help retain the vegetative structure of the chaparral community and the wildlife guilds that use this habitat.

Range management practices that reduce the midstory structure of chaparral communities over large areas will also impact the wildlife resources in this habitat type. Management techniques, such as wide scale herbicidal application, burning, and chaining of chaparral vegetation, to increase the grass cover for improved livestock grazing, will deleteriously affect five guilds of primary consumers and five guilds of secondary consumers. These land management actions also adversely affect eight guilds of primary consumers and 11 guilds of secondary consumers (Table 7).

The periodic regeneration of small units of chaparral habitat (by controlled burning or mechanical techniques) should increase the production of current annual growth, which is advantageous to the wildlife community.

Table 5. Wildlife guilds of primary consumers in chaparral habitats of westcentral Arizona.

GUILD NO.	GUILD MEMBERS[a]	FEEDING LOCI[b]										BREEDING LOCI[c]									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
1	BLACK BEAR				4	5	6									5	6				
	COLLARED PECCARY				4	5	6									5	6				
	DEER MOUSE				4	5	6									5	6				
	CACTUS MOUSE				4	5	6									5	6				
	COYOTE				4	5	6									5	6				
2	STRIPED SKUNK				4	5										5	6				
	HOG-NOSED SKUNK				4	5										5	6				
3	BOTTA'S POCKET GOPHER				4	5										5					
4	WHITE-THROATED WOODRAT					5	6									5	6	7			
5	BIGHORN SHEEP					5	6									5	6				
	GRAY FOX					5	6									5	6				
	STEPHENS' WOODRAT					5	6									5	6				
	RINGTAIL					5	6									5	6				
	BRUSH MOUSE					5	6									5	6				
6	HARRIS' ANTELOPE SQUIRREL					5	6									5					
7	BROWN-HEADED COWBIRD					5	6										6	7			
	HOUSE FINCH					5	6										6	7			
	MOCKINGBIRD					5	6										6	7			
	CACTUS WREN					5	6										6	7			
	COSTA'S HUMMINGBIRD					5	6										6	7			
	WESTERN HARVEST MOUSE					5	6										6	7			
	CRISSAL THRASHER					5	6										6	7			
8	MULE DEER					5	6										6				
	ROCK SQUIRREL					5	6										6				
	CATTLE					5	6										6				
9	SCRUB JAY					5	6											7			
	BUSHTIT					5	6											7			

Table 5. (continued).

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
10	SCOTT'S ORIOLE					5	6														10
	AMERICAN ROBIN					5	6														10
	LESSER GOLDFINCH					5	6														10
	TOWNSEND'S SOLITAIRE					5	6														10
	ANNA'S HUMMINGBIRD					5	6														10
	LEWIS' WOODPECKER					5	6														10
	BLUE GROSBEAK					5	6														10
	BLACK-CHINNED HUMMINGBIRD					5	6														10
	ACORN WOODPECKER					5	6														10
	BROAD-TAILED HUMMINGBIRD					5	6														10
	CASSIN'S KINGBIRD					5	6														10
	MOUNTAIN BLUEBIRD					5	6														10
	RUFOUS HUMMINGBIRD					5	6														10
	STARLING					5	6														10
	PINON JAY					5	6														10
	CALLIOPE HUMMINGBIRD					5	6														10
	GREEN-TAILED TOWHEE					5	6														10
	BLACK-HEADED GROSBEAK					5	6														10
	AMERICAN GOLDFINCH					5	6														10
	COMMON FLICKER					5	6														10
	STELLER'S JAY					5	6														10
	LADDER-BACKED WOODPECKER					5	6														10
	LAZULI BUNTING					5	6														10
	YELLOW-RUMPED WARBLER					5	6														10
	WESTERN KINGBIRD					5	6														10
	SWAINSON'S THRUSH					5	6														10
	ELK					5	6														10
	HERMIT THRUSH					5	6														10
	WHITE-WINGED DOVE					5	6														10
	WESTERN BLUEBIRD					5	6														10
11	DESERT SPINY LIZARD					5										5	6				
	CANYON MOUSE					5										5	6				
	WESTERN SPOTTED SKUNK					5										5	6				
	CLIFF CHIPMUNK					5										5	6				
	ARIZONA WOODRAT					5										5	6				
12	SOUTHERN GRASSHOPPER MOUSE					5										5					
	ORD'S KANGAROO RAT					5										5					
	NORTHERN GRASSHOPPER MOUSE					5										5					
	DESERT TORTOISE					5										5					

Table 5. (continued).

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
13	MOURNING DOVE					5											6	7			
14	RUFOUS-SIDED TOWHEE					5											6				
	EASTERN COTTONTAIL					5											6				
	BLACK-TAILED JACK RABBIT					5											6				
	COMMON RAVEN					5											6				
	ROCK DOVE					5											6				
	GAMBEL'S QUAIL					5											6				
	HOUSE MOUSE					5											6				
	DESERT COTTONTAIL					5											6				
	RUFOUS-CROWNED SPARROW					5											6				
15	BROWN TOWHEE					5												7			
	BLACK-CHINNED SPARROW					5												7			
	BLACK-THROATED SPARROW					5												7			
16	WESTERN MEADOWLARK					5															10
	LARK SPARROW					5															10
	CHIPPING SPARROW					5															10
	FOX SPARROW					5															10
	PURPLE FINCH					5															10
	BREWER'S SPARROW					5															10
	DARK-EYED JUNCO					5															10
	WHITE-CROWNED SPARROW					5															10
	WATER PIPIT					5															10
17	SAY'S PHOEBE						6									5	6				
18	VERDIN						6											7			

Table 5. (concluded).

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
19	HOODED ORIOLE						6														10
	WARBLING VIREO						6														10
	PHAINOPEPLA						6														10
	RUBY-CROWNED KINGLET						6														10
	PLAIN TITMOUSE						6														10
	ASH-THROATED FLYCATCHER						6														10
	WIED'S CRESTED FLYCATCHER						6														10
	NORTHERN ORIOLE						6														10
	YELLOW-BELLIED SAPSUCKER						6														10
	HERMIT WARBLER						6														10

[a]Scientific names of species are listed in Appendix I.

[b]Feeding habitat layer or condition:

1 = Bottom of water column
2 = Water column
3 = Water surface
4 = Terrestrial subsurface
5 = Terrestrial surface
6 = Shrub or midstory layer
7 = Tree bole
8 = Tree canopy
9 = Air
10 = Feeds elsewhere

[c]Breeding habitat layer or condition:

1 = Temporary water sources
2 = Bottom of water column
3 = Water column
4 = Water surface
5 = Terrestrial subsurface
6 = Terrestrial surface
7 = Shrub or midstory layer
8 = Tree bole
9 = Tree canopy
10 = Breeds elsewhere

Table 6. Wildlife guilds of secondary consumers in chaparral habitats of westcentral Arizona. The interpretation of the table is as in Table 5.

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
1	GOPHER SNAKE				4	5	6									5	6				
	COYOTE				4	5	6									5	6				
	RINGTAIL				4	5	6									5	6				
	BLACK BEAR				4	5	6									5	6				
	STRIPED WHIPSNAKE				4	5	6									5	6				
2	GILBERT'S SKINK				4	5										5	6				
	MEXICAN BLACK-HEADED SNAKE				4	5										5	6				
	GLOSSY SNAKE				4	5										5	6				
	GREAT PLAINS SKINK				4	5										5	6				
	LONG-NOSED SNAKE				4	5										5	6				
	STRIPED SKUNK				4	5										5	6				
	HOG-NOSED SKUNK				4	5										5	6				
	COLLARED PECCARY				4	5										5	6				
3	BADGER				4	5										5					
	GILA MONSTER				4	5										5					
4	GREAT HORNED OWL					5	6			9						5	6				
	FRINGED MYOTIS					5	6			9						5	6				
	PALLID BAT					5	6			9						5	6				
5	COSTA'S HUMMINGBIRD					5	6			9							6	7			
6	BLUE-GRAY GNATCATCHER					5	6			9								7			
	LOGGERHEAD SHRIKE					5	6			9								7			
	GRAY VIREO					5	6			9								7			

Table 6. (continued).

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
7	WILSON'S WARBLER					5	6			9											10
	WESTERN FLYCATCHER					5	6			9											10
	TOWNSEND'S SOLITAIRE					5	6			9											10
	SWAINSON'S THRUSH					5	6			9											10
	WESTERN BLUEBIRD					5	6			9											10
	LEWIS' WOODPECKER					5	6			9											10
	MOUNTAIN BLUEBIRD					5	6			9											10
	CALLIOPE HUMMINGBIRD					5	6			9											10
	LADDER-BACKED WOODPECKER					5	6			9											10
	SCOTT'S ORIOLE					5	6			9											10
	STARLING					5	6			9											10
	VIRGINIA'S WARBLER					5	6			9											10
	RUBY-CROWNED KINGLET					5	6			9											10
	PAINTED REDSTART					5	6			9											10
	YELLOW-RUMPED WARBLER					5	6			9											10
	RUFOUS HUMMINGBIRD					5	6			9											10
	WARBLING VIREO					5	6			9											10
	BLACK-CHINNED HUMMINGBIRD					5	6			9											10
	ANNA'S HUMMINGBIRD					5	6			9											10
	DUSKY FLYCATCHER					5	6			9											10
	LEAST FLYCATCHER					5	6			9											10
	LUCY'S WARBLER					5	6			9											10
	WIED'S CRESTED FLYCATCHER					5	6			9											10
	NORTHERN ORIOLE					5	6			9											10
	WILLOW FLYCATCHER					5	6			9											10
	HAMMOND'S FLYCATCHER					5	6			9											10
	GRAY FLYCATCHER					5	6			9											10
	HOODED ORIOLE					5	6			9											10
	ACORN WOODPECKER					5	6			9											10
	ASH-THROATED FLYCATCHER					5	6			9											10
	BROAD-TAILED HUMMINGBIRD					5	6			9											10
	COMMON FLICKER					5	6			9											10
8	CANYON WREN					5	6									5	6				
	SONORA WHIPSNAKE					5	6									5	6				
	BOBCAT					5	6									5	6				
	DEER MOUSE					5	6									5	6				
	DESERT SPINY LIZARD					5	6									5	6				
	STRIPED RACER					5	6									5	6				
	MOUNTAIN LION					5	6									5	6				
	ROCK WREN					5	6									5	6				
9	CACTUS WREN					5	6										6	7			
	BROWN-HEADED COWBIRD					5	6										6	7			
	MOCKINGBIRD					5	6										6	7			
	WESTERN HARVEST MOUSE					5	6										6	7			
	CRISSAL THRASHER					5	6										6	7			

Table 6. (continued).

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
10	LONG-TAIL BRUSH LIZARD					5	6										6				
	SOUTHERN PLATEAU LIZARD					5	6										6				
	COMMON RAVEN					5	6										6				
	AMERICAN KESTREL					5	6										6				
11	SCRUB JAY					5	6											7			
	BLACK-CHINNED SPARROW					5	6											7			
12	PINON JAY					5	6														10
	SCREECH OWL					5	6														10
	STELLER'S JAY					5	6														10
	ZONE-TAILED HAWK					5	6														10
	GOSHAWK					5	6														10
	MACGILLIVRAY'S WARBLER					5	6														10
	BEWICK'S WREN					5	6														10
	SHARP-SHINNED HAWK					5	6														10
	LAZULI BUNTING					5	6														10
	HERMIT THRUSH					5	6														10
	BLUE GROSBEAK					5	6														10
	COOPER'S HAWK					5	6														10
	COMMON YELLOWTHROAT					5	6														10
	HOUSE WREN					5	6														10
	ORANGE-CROWNED WARBLER					5	6														10
	BLACK-THROATED GRAY WARBLER					5	6														10
13	SAY'S PHOEBE					5				9						5	6				
	SMALL-FOOTED MYOTIS					5				9						5	6				
14	POOR-WILL					5				9							6				
	LESSER NIGHTHAWK					5				9							6				
15	WESTERN MEADOWLARK					5				9											10
	CASSIN'S KINGBIRD					5				9											10
	WESTERN KINGBIRD					5				9											10
16	NIGHT SNAKE					5										5	6				
	CLIFF CHIPMUNK					5										5	6				
	BLACK-TAILED RATTLESNAKE					5										5	6				
	GRAY FOX					5										5	6				
	ZEBRA-TAILED LIZARD					5										5	6				
	GREATER EARLESS LIZARD					5										5	6				
	ARIZONA BLACK RATTLESNAKE					5										5	6				
	WESTERN DIAMONDBACK RATTLESNAKE					5										5	6				
	COLLARED LIZARD					5										5	6				
	BRUSH MOUSE					5										5	6				
	CANYON MOUSE					5										5	6				
	CACTUS MOUSE					5										5	6				
	SIDE-BLOTCHED LIZARD					5										5	6				
	WESTERN SPOTTED SKUNK					5										5	6				

Table 6. (continued).

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
17	SOUTHERN GRASSHOPPER MOUSE					5										5					
	HARRIS' ANTELOPE SQUIRREL					5										5					
	NORTHERN GRASSHOPPER MOUSE					5										5					
18	ROADRUNNER					5											6	7			
19	SHORT-HORNED LIZARD					5											6				
	PRAIRIE FALCON					5											6				
	ROCK SQUIRREL					5											6				
	ARIZONA NIGHT LIZARD					5											6				
	RUFOUS-SIDED TOWHEE					5											6				
	GOLDEN EAGLE					5											6				
	GAMBEL'S QUAIL					5											6				
	PLATEAU WHIPTAIL					5											6				
	HOUSE MOUSE					5											6				
	TURKEY VULTURE					5											6				
	CALIFORNIA WHIPTAIL					5											6				
	DESERT SHREW					5											6				
	RUFOUS-CROWNED SPARROW					5											6				
	CHIHUAHUAN WHIPTAIL					5											6				
20	RED-TAILED HAWK					5												7			
	BROWN TOWHEE					5												7			
	BLACK-THROATED SPARROW					5												7			
21	CHECKERED GARTER SNAKE					5															10
	SOUTHWEST TOAD					5															10
	RED-SPOTTED TOAD					5															10
	DARK-EYED JUNCO					5															10
	LARK SPARROW					5															10
	CHIPPING SPARROW					5															10
	WHITE-CROWNED SPARROW					5															10
	AMERICAN ROBIN					5															10
	LONG-EARED OWL					5															10
	BLACK-HEADED GROSBEAK					5															10
	GREEN-TAILED TOWHEE					5															10
	BREWER'S SPARROW					5															10
	BLACK-NECKED GARTER SNAKE					5															10
	WATER PIPIT					5															10
	FOX SPARROW					5															10
22	SOLITARY VIREO						6			9											10
	HERMIT WARBLER						6			9											10
	WESTERN TANAGER						6			9											10
	YELLOW-BELLIED SAPSUCKER						6			9											10
	HEPATIC TANAGER						6			9											10

Table 6. (concluded).

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
23	VERDIN						6											7			
	BUSHTIT						6											7			
24	PLAIN TITMOUSE						6														10
	TOWNSEND'S WARBLER						6														10
	PHAINOPEPLA						6														10
25	TOWNSEND'S BIG-EARED BAT									9						5	6				
	WHITE-THROATED SWIFT									9						5	6				
	CALIFORNIA MYOTIS									9						5	6				
	YUMA MYOTIS									9						5	6				
	CAVE MYOTIS									9						5	6				
	BRAZILIAN FREE-TAILED BAT									9						5	6				
	SPOTTED BAT									9						5	6				
	LONG-LEGGED MYOTIS									9						5	6				
	BIG BROWN BAT									9						5	6				
	WESTERN PIPISTRELLE									9						5	6				
26	ROUGH-WINGED SWALLOW									9						5					
27	CLIFF SWALLOW									9							6				
28	TREE SWALLOW									9											10
	BARN SWALLOW									9											10
	BLACK SWIFT									9											10
	VIOLET-GREEN SWALLOW									9											10
	VAUX'S SWIFT									9											10

Table 7. Effects of habitat alterations on primary consumer and secondary consumer guilds in chaparral habitats (total of 47 guilds).

Impacted guilds	Impacted system or layer of habitat				
	Aquatic	Understory	Midstory	Tree bole	Overstory
Deleterious impacts					
Primary consumers[a]		8, 11-16	9, 15, 17-19		
Secondary consumers[b]		10, 14, 16-21	6, 11, 20, 23-24		
Totals		15 guilds (70 species)	10 guilds (22 species)		
Adverse impacts					
Primary consumers[a]		1-7, 9-10, 17	1, 4-8, 10, 13		
Secondary consumers[b]		c	1, 4-5, 7-10, 12, 18, 22		
Totals		10 + guilds (40+ species)	18 guilds (102 species)		

[a]See Table 5 for a list of species in each identified primary consumer guild.

[b]See Table 6 for a list of species in each identified secondary consumer guild.

[c]Additional guilds of secondary consumers will be adversely affected because of changes in their food chains due to the reduced biomass of primary consumers.

Cottonwood-Willow Riparian Habitat

Slender fingers of cottonwood-willow habitat occur along drainages that transect some lower and a few upper Sonoran Desert vegetation cover types in the study area. This habitat provides both an interface with an aquatic system and the structure of a treeland. Eight layers of habitat potentially occur in this habitat type. Three layers are associated with the aquatic system (bottom of water column, water column, and surface of water column) and five layers with the terrestrial system (subsurface, surface, midstory, tree bole, and tree canopy). Riparian areas containing cottonwoods (Populus fremontii) and willows (Salix spp.) comprise far less than 1% of the west-central Arizona study area (Millsap 1981), but potentially provide habitat for 253 vertebrate species. This represents the greatest potential species richness of the 14 habitat types considered in this analysis (Appendix II). The potential wildlife community is arrayed into 63 guilds of primary consumers (Table 8) and 106 guilds of secondary consumers (Table 9).

Cottonwood-willow riparian areas provide habitat for fish, amphibians, reptiles, birds, and mammals. Because of the large number of layers potentially present in this community, there are many ways in which the habitat resources can be utilized by wildlife. Cottonwood-willow riparian habitats should be managed as rare and endangered vegetation communities because of their uniqueness and great value to wildlife. The impacts of some potential habitat modifications on wildlife resources are described below.

Dewatering of streams to the extent that the flow becomes intermittent instead of permanent will deleteriously affect nine guilds of primary consumers and 14 guilds of secondary consumers (Table 10). In addition, seven guilds of primary consumers and 24 guilds of secondary consumers will be adversely affected.

Heavy grazing of cottonwood-willow riparian habitats will deleteriously affect those guilds of wildlife species solely dependent on surface vegetation for breeding or feeding activities. Thirteen guilds of primary consumers will be deleteriously affected and 36 guilds of primary consumers will be adversely affected by this action (Table 10). Eighteen guilds of secondary consumers (Table 10) will be deleteriously affected by the reduction in breeding substrate. Other guilds of secondary consumers will be impacted because of changes in their food chains, resulting from the reduction in primary production in the surface layer. The impact of heavy grazing on wildlife guilds in these habitats may be very great; Millsap (1981) has indicated that the basic structure of the vegetative community may be altered when livestock congregrate in riparian streamers, impacting layers of habitat other than the terrestrial surface.

Extensive modification of the structure of the shrub or midstory layer will deleteriously impact three guilds of primary consumers and four guilds of secondary consumers. Thirty-seven guilds of primary consumers and 57 guilds of secondary consumers will be adversely affected.

Destruction or removal of snags or large tree boles will deleteriously affect three guilds of primary consumers and six guilds of secondary consumers (Table 10). Fourteen guilds of primary consumers and 33 guilds of secondary consumers will be adversely affected.

Destruction or removal of the tree canopy will deleteriously affect one primary consumer guild and three guilds of secondary consumers. In addition, 30 guilds of primary consumers and 44 guilds of secondary consumers will be adversely affected.

The best management policy for riparian habitats in the Sonoran Desert from a wildlife perspective is to protect their vegetative structure from as many destructive influences as possible because these areas provide unique habitat for a large number of wildlife species.

Table 8. Wildlife guilds of primary consumers in cottonwood-willow riparian habitats in westcentral Arizona. The interpretation of the table is as in Table 5.

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
1	AMERICAN COOT	1	2	3		5									4						
2	MALLARD	1	2	3		5											6				
3	CANADA GOOSE	1	2	3		5															10
	GADWALL	1	2	3		5															10
4	LONGFIN DACE	1	2	3									2	3	4						
	RED SHINER	1	2	3									2	3	4						
5	GILA SUCKER	1	2	3									2		4						
6	CARP	1	2										2	3							
	SPECKLED DACE	1	2										2	3							
7	BLACK BULLHEAD	1											2								
	YELLOW BULLHEAD	1											2								
	GILA MOUNTAIN-SUCKER	1											2								
8	ROUNDTAIL CHUB		2	3										3	4						
9	GREEN SUNFISH		2											3	4						
10	SOFT-SHELLED TURTLE		2														6				
11	PORCUPINE			3	4	5	6		8								5	6				
12	BEAVER			3	4	5	6									4	5				
13	MUSKRAT			3		5										4	5				
14	CINNAMON TEAL			3		5											6				
15	SPOTTED SANDPIPER			3		5															10
16	NORTHERN SHOVELER			3																	10
17	BLACK BEAR				4	5	6	7	8												10
18	CACTUS MOUSE				4	5	6		8								5	6			
19	COLLARED PECCARY				4	5	6										5	6			
	DEER MOUSE				4	5	6										5	6			
	COYOTE				4	5	6										5	6			

Table 8. (continued).

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
20	STRIPED SKUNK				4	5										5	6				
	HOG-NOSED SKUNK				4	5										5	6				
21	BOTTA'S POCKET GOPHER				4	5										5					
22	COMMON FLICKER					5	6	7	8							5			8		
23	BLACK-CHINNED HUMMINGBIRD					5	6	7	8								6	7		9	
24	COSTA'S HUMMINGBIRD					5	6	7	8								6				
25	ACORN WOODPECKER					5	6	7	8												10
	RUFOUS HUMMINGBIRD					5	6	7	8												10
	ANNA'S HUMMINGBIRD					5	6	7	8												10
	BROAD-TAILED HUMMINGBIRD					5	6	7	8												10
	CALLIOPE HUMMINGBIRD					5	6	7	8												10
	SCOTT'S ORIOLE					5	6	7	8												10
	YELLOW-RUMPED WARBLER					5	6	7	8												10
26	RACCOON					5	6		8							5	6	7	8		
27	RINGTAIL					5	6		8							5	6		8		
28	GRAY FOX					5	6		8							5	6				
29	STARLING					5	6		8							5			8		
30	WESTERN HARVEST MOUSE					5	6		8								6	7	8		
31	AMERICAN ROBIN					5	6		8								6	7		9	
	MOCKINGBIRD					5	6		8								6	7		9	
	GREAT-TAILED GRACKLE					5	6		8								6	7		9	
	LESSER GOLDFINCH					5	6		8								6	7		9	
32	ROCK SQUIRREL					5	6		8								6				
33	WESTERN KINGBIRD					5	6		8									7	8	9	
	CASSIN'S KINGBIRD					5	6		8									7	8	9	
34	BUSHTIT					5	6		8									7		9	
35	LADDER-BACKED WOODPECKER					5	6		8										8		
	GILA WOODPECKER					5	6		8										8		
36	WHITE-WINGED DOVE					5	6		8											9	

Table 8. (continued).

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
37	SCRUB JAY					5	6		8												10
	MOUNTAIN BLUEBIRD					5	6		8												10
	PINE SISKIN					5	6		8												10
	LAWRENCE'S GOLDFINCH					5	6		8												10
	COMMON CROW					5	6		8												10
	RUBY-CROWNED KINGLET					5	6		8												10
	AMERICAN GOLDFINCH					5	6		8												10
	WESTERN BLUEBIRD					5	6		8												10
	STELLER'S JAY					5	6		8												10
	TOWNSEND'S SOLITAIRE					5	6		8												10
	LEWIS' WOODPECKER					5	6		8												10
38	WHITE-THROATED WOODRAT					5	6									5	6	7			
39	BRUSH MOUSE					5	6									5	6				
40	HARRIS' ANTELOPE SQUIRREL					5	6									5					
41	CACTUS WREN					5	6										6	7	8	9	
	HOUSE FINCH					5	6										6	7	8	9	
42	BROWN-HEADED COWBIRD					5	6										6	7		9	
43	LAZULI BUNTING					5	6										6	7			
	YELLOW-BREASTED CHAT					5	6										6	7			
	CRISSAL THRASHER					5	6										6	7			
	RED-WINGED BLACKBIRD					5	6										6	7			
44	MULE DEER					5	6										6				
	BURRO					5	6										6				
	CATTLE					5	6										6				
45	HOUSE SPARROW					5	6											7	8	9	
46	BLUE GROSBEAK					5	6											7			
	CARDINAL					5	6											7			
47	GREEN-TAILED TOWHEE					5	6														10
	BREWER'S BLACKBIRD					5	6														10
	HERMIT THRUSH					5	6														10
	SWAINSON'S THRUSH					5	6														10
	YELLOW-HEADED BLACKBIRD					5	6														10
48	CASSIN'S FINCH					5			8												10
	PURPLE FINCH					5			8												10

Table 8. (continued).

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
49	DESERT SPINY LIZARD					5										5	6				
	ARIZONA WOODRAT					5										5	6				
	CANYON MOUSE					5										5	6				
	WESTERN SPOTTED SKUNK					5										5	6				
50	ROCK POCKET MOUSE					5										5					
	SOUTHERN GRASSHOPPER MOUSE					5										5					
51	MOURNING DOVE					5											6	7		9	
52	SONG SPARROW					5											6	7			
	ABERT'S TOWHEE					5											6	7			
53	COMMON RAVEN					5											6		8	9	
54	EASTERN COTTONTAIL					5											6				
	DESERT COTTONTAIL					5											6				
	BLACK-TAILED JACK RABBIT					5											6				
	HOUSE MOUSE					5											6				
	GAMBEL'S QUAIL					5											6				
	ROCK DOVE					5											6				
55	DARK-EYED JUNCO					5															10
	WATER PIPIT					5															10
	LINCOLN'S SPARROW					5															10
	TREE SWALLOW					5															10
	RUFOUS-SIDED TOWHEE					5															10
	FOX SPARROW					5															10
	CHIPPING SPARROW					5															10
	WHITE-CROWNED SPARROW					5															10
56	CEDAR WAXWING						6	7	8												10
	YELLOW-BELLIED SAPSUCKER						6	7	8												10
57	SAY'S PHOEBE						6		8							5	6				
58	SUMMER TANAGER						6		8									7		9	
	NORTHERN ORIOLE						6		8									7		9	
	PHAINOPEPLA						6		8									7		9	
	HOODED ORIOLE						6		8									7		9	
59	VERDIN						6		8									7			
60	WHITE-BREASTED NUTHATCH						6		8										8		
	BRIDLED TITMOUSE						6		8										8		
	ASH-THROATED FLYCATCHER						6		8										8		
	WIED'S CRESTED FLYCATCHER						6		8										8		

Table 8. (concluded).

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
61	PLAIN TITMOUSE						6		8												10
	WESTERN TANAGER						6		8												10
	HAIRY WOODPECKER						6		8												10
	WARBLING VIREO						6		8												10
62	HERMIT WARBLER						6														10
63	WILLIAMSON'S SAPSUCKER							7													10

Table 9. Wildlife guilds of secondary consumers in cottonwood-willow riparian habitats in westcentral Arizona. The interpretation of the table is as in Table 5.

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
1	MUSKRAT	1	2	3		5									4	5					
2	AMERICAN COOT	1	2	3		5									4						
3	GREAT BLUE HERON	1	2	3		5											6			9	
4	MALLARD	1	2	3		5											6				
5	GREAT EGRET	1	2	3		5												7		9	
	BLACK-CROWNED NIGHT HERON	1	2	3		5												7		9	
	GREEN HERON	1	2	3		5												7		9	
6	CANADA GOOSE	1	2	3		5															10
	AMERICAN BITTERN	1	2	3		5															10
	SNOWY EGRET	1	2	3		5															10
7	LONGFIN DACE	1	2	3									2	3	4						
	RED SHINER	1	2	3									2	3	4						
8	GILA SUCKER	1	2	3									2		4						
9	PIED-BILLED GREBE	1	2	3											4						
10	COMMON MERGANSER	1	2	3												5	6		8		
11	EARED GREBE	1	2	3																	10
12	SPECKLED DACE	1	2										2	3							
	CARP	1	2										2	3							
13	RACCOON	1		3		5	6		8							5	6	7	8		
14	WHITE-FACED IBIS	1		3		5															10
15	YELLOW BULLHEAD	1											2								
	BLACK BULLHEAD	1											2								
	GILA MOUNTAIN-SUCKER	1											2								
16	BLACK-NECKED GARTER SNAKE		2	3		5											6				

Table 9. (continued).

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
17	ROUNDTAIL CHUB		2	3										3	4						
	GREEN SUNFISH		2	3										3	4						
18	SOFT-SHELLED TURTLE		2	3													6				
	YELLOW MUD TURTLE		2	3													6				
	SONORA MUD TURTLE		2	3													6				
19	CHECKERED GARTER SNAKE		2			5											6				
20	COYOTE			3	4	5	6									5	6				
21	STRIPED SKUNK			3	4	5										5	6				
	HOG-NOSED SKUNK			3	4	5										5	6				
22	BLACK BEAR			3	4	5															10
	BADGER			3	4	5															10
23	COOPER'S HAWK			3		5	6	7	8	9								7		9	
24	COMMON RAVEN			3		5	6	7	8								6		8	9	
25	BLACK HAWK			3		5	6	7	8											9	
26	RED-WINGED BLACKBIRD			3		5	6			9							6	7			
27	BREWER'S BLACKBIRD			3		5	6			9											10
	YELLOW-HEADED BLACKBIRD			3		5	6			9											10
	LONG-BILLED MARSH WREN			3		5	6			9											10
28	BOBCAT			3		5	6									5	6				
29	GREAT-TAILED GRACKLE			3		5	6										6	7		9	
30	LEAST BITTERN			3		5	6														10
31	BLACK PHOEBE			3		5				9							6				
32	LEOPARD FROG			3		5									4						
33	GRAY FOX			3		5										5	6				
	WESTERN SPOTTED SKUNK			3		5										5	6				
34	CINNAMON TEAL			3		5											6				

Table 9. (continued).

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
35	NORTHERN WATERTHRUSH			3		5															10
	BALD EAGLE			3		5															10
36	NORTHERN SHOVELER			3																	10
	DIPPER			3																	10
	SPOTTED SANDPIPER			3																	10
	BELTED KINGFISHER			3																	10
37	RINGTAIL				4	5	6		8								5	6		8	
38	GOPHER SNAKE				4	5	6										5	6			
39	GILBERT'S SKINK				4	5											5	6			
	MEXICAN BLACK-HEADED SNAKE				4	5											5	6			
	COLLARED PECCARY				4	5											5	6			
	WESTERN BLIND SNAKE				4	5											5	6			
	WESTERN PATCH-NOSED SNAKE				4	5											5	6			
	LONG-NOSED SNAKE				4	5											5	6			
	GLOSSY SNAKE				4	5											5	6			
40	GREAT PLAINS SKINK				4	5											5				
	CORAL SNAKE				4	5											5				
41	GREAT HORNED OWL					5	6	7	8	9							5	6		8	9
42	STARLING					5	6	7	8	9							5			8	
	COMMON FLICKER					5	6	7	8	9							5			8	
43	BLACK-CHINNED HUMMINGBIRD					5	6	7	8	9								6	7		9
44	AMERICAN KESTREL					5	6	7	8	9								6		8	
45	COSTA'S HUMMINGBIRD					5	6	7	8	9								6			
46	NORTHERN ORIOLE					5	6	7	8	9									7		9
	YELLOW WARBLER					5	6	7	8	9									7		9
	HOODED ORIOLE					5	6	7	8	9									7		9
47	BELL'S VIREO					5	6	7	8	9									7		
48	GILA WOODPECKER					5	6	7	8	9										8	
	ELF OWL					5	6	7	8	9										8	
	LADDER-BACKED WOODPECKER					5	6	7	8	9										8	
	WHITE-BREASTED NUTHATCH					5	6	7	8	9										8	

Table 9. (continued).

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
49	GOLDEN-CROWNED KINGLET					5	6	7	8	9											10
	RUFOUS HUMMINGBIRD					5	6	7	8	9											10
	BROAD-TAILED HUMMINGBIRD					5	6	7	8	9											10
	ACORN WOODPECKER					5	6	7	8	9											10
	WARBLING VIREO					5	6	7	8	9											10
	SCOTT'S ORIOLE					5	6	7	8	9											10
	YELLOW-RUMPED WARBLER					5	6	7	8	9											10
	ANNA'S HUMMINGBIRD					5	6	7	8	9											10
	LEWIS' WOODPECKER					5	6	7	8	9											10
	CALLIOPE HUMMINGBIRD					5	6	7	8	9											10
	RUBY-CROWNED KINGLET					5	6	7	8	9											10
50	WESTERN HARVEST MOUSE					5	6	7	8								6	7	8		
51	BEWICK'S WREN					5	6	7	8								6		8		
52	ZONE-TAILED HAWK					5	6	7	8											9	
53	SHARP-SHINNED HAWK					5	6	7	8												10
	SCRUB JAY					5	6	7	8												10
	HOUSE WREN					5	6	7	8												10
	STELLER'S JAY					5	6	7	8												10
	BLACK-THROATED GRAY WARBLER					5	6	7	8												10
	ORANGE-CROWNED WARBLER					5	6	7	8												10
54	ROCK WREN					5	6	7								5	6				
	DESERT SPINY LIZARD					5	6	7								5	6				
	CANYON WREN					5	6	7								5	6				
55	PALLID BAT					5	6		8	9						5	6		8		
56	CALIFORNIA LEAF-NOSED BAT					5	6		8	9						5	6				
	FRINGED MYOTIS					5	6		8	9						5	6				
57	WILLOW FLYCATCHER					5	6		8	9							6	7			
58	BLUE-GRAY GNATCATCHER					5	6		8	9								7		9	
59	ASH-THROATED FLYCATCHER					5	6		8	9									8		
	WIED'S CRESTED FLYCATCHER					5	6		8	9									8		
	RED BAT					5	6		8	9									8		
60	GRAY FLYCATCHER					5	6		8	9											10
	LEAST FLYCATCHER					5	6		8	9											10
	HAMMOND'S FLYCATCHER					5	6		8	9											10
	DUSKY FLYCATCHER					5	6		8	9											10
	WESTERN FLYCATCHER					5	6		8	9											10

Table 9. (continued).

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
61	CACTUS WREN					5	6		8								6	7	8	9	
62	LAZULI BUNTING					5	6		8								6	7			
63	BLUE GROSBEAK					5	6		8									7			
64	SCREECH OWL					5	6		8										8		
65	COMMON CROW					5	6		8												10
66	BLACK-TAILED GNATCATCHER					5	6			9							6	7			
67	HOUSE SPARROW					5	6			9								7	8	9	
68	LOGGERHEAD SHRIKE					5	6			9								7		9	
69	LUCY'S WARBLER					5	6			9									8		
70	SWAINSON'S THRUSH					5	6			9											10
	MOUNTAIN BLUEBIRD					5	6			9											10
	VIRGINIA'S WARBLER					5	6			9											10
	WILSON'S WARBLER					5	6			9											10
	WESTERN BLUEBIRD					5	6			9											10
	PAINTED REDSTART					5	6			9											10
	TOWNSEND'S SOLITAIRE					5	6			9											10
71	COACHWHIP					5	6									5	6				
	DEER MOUSE					5	6									5	6				
	MOUNTAIN LION					5	6									5	6				
	CALIFORNIA KING SNAKE					5	6									5	6				
72	MOCKINGBIRD					5	6										6	7		9	
	BROWN-HEADED COWBIRD					5	6										6	7		9	
73	COMMON YELLOWTHROAT					5	6										6	7			
	SONG SPARROW					5	6										6	7			
	ABERT'S TOWHEE					5	6										6	7			
	CRISSAL THRASHER					5	6										6	7			
	YELLOW-BREASTED CHAT					5	6										6	7			
74	SOUTHERN PLATEAU LIZARD					5	6										6				
75	CARDINAL					5	6											7			

Table 9. (continued).

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
76	MACGILLIVRAY'S WARBLER					5	6														10
	GREEN-TAILED TOWHEE					5	6														10
	HERMIT THRUSH					5	6														10
77	BROWN CREEPER					5		7													10
78	SAY'S PHOEBE					5				9						5	6				
	SMALL-FOOTED MYOTIS					5				9						5	6				
79	WESTERN KINGBIRD					5				9								7	8	9	
	CASSIN'S KINGBIRD					5				9								7	8	9	
80	WESTERN WOOD PEWEE					5				9								7		9	
	VERMILION FLYCATCHER					5				9								7		9	
81	LESSER NIGHTHAWK					5				9											10
82	COLORADO RIVER TOAD					5								3							
83	RED-SPOTTED TOAD					5									4						
	COUCH'S SPADEFOOT TOAD					5									4						
	CANYON TREE FROG					5									4						
	SOUTHWEST TOAD					5									4						
84	GREATER EARLESS LIZARD					5										5	6				
	WESTERN DIAMONDBACK RATTLESNAKE					5										5	6				
	MOHAVE RATTLESNAKE					5										5	6				
	BRUSH MOUSE					5										5	6				
	CANYON MOUSE					5										5	6				
	CACTUS MOUSE					5										5	6				
	SPECKLED RATTLESNAKE					5										5	6				
	SIDE-BLOTCHED LIZARD					5										5	6				
	ZEBRA-TAILED LIZARD					5										5	6				
85	SOUTHERN GRASSHOPPER MOUSE					5										5					
	HARRIS' ANTELOPE SQUIRREL					5										5					
86	AMERICAN ROBIN					5											6	7		9	
87	ROADRUNNER					5											6	7			

Table 9. (continued).

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
88	RED-TAILED HAWK					5											6		8	9	
89	TURKEY VULTURE					5											6				
	HOUSE MOUSE					5											6				
	GAMBEL'S QUAIL					5											6				
	DESERT SHREW					5											6				
	CALIFORNIA WHIPTAIL					5											6				
	SPOTTED LEAF-NOSE SNAKE					5											6				
	KILLDEER					5											6				
	ROCK SQUIRREL					5											6				
90	WHITE-CROWNED SPARROW					5															10
	FOX SPARROW					5															10
	CHIPPING SPARROW					5															10
	LINCOLN'S SPARROW					5															10
	RUFOUS-SIDED TOWHEE					5															10
	WATER PIPIT					5															10
	DARK-EYED JUNCO					5															10
91	SUMMER TANAGER						6	7	8	9								7		9	
92	YELLOW-BELLIED SAPSUCKER						6	7	8	9											10
	CEDAR WAXWING						6	7	8	9											10
	WESTERN TANAGER						6	7	8	9											10
	SOLITARY VIREO						6	7	8	9											10
	HAIRY WOODPECKER						6	7	8	9											10
	AMERICAN REDSTART						6	7	8	9											10
	HERMIT WARBLER						6	7	8	9											10
93	BUSHTIT						6	7	8									7		9	
	PHAINOPEPLA						6	7	8									7		9	
94	VERDIN						6	7	8									7			
95	BRIDLED TITMOUSE						6	7	8										8		
96	PLAIN TITMOUSE						6	7	8												10
	TOWNSEND'S WARBLER						6	7	8												10
	WILLIAMSON'S SAPSUCKER						6	7	8												10
97	TREE LIZARD						6	7									6				
	LONG-TAIL BRUSH LIZARD						6	7									6				
98	YELLOW-BILLED CUCKOO						6		8									7		9	

Table 9. (concluded).

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
99	LONG-LEGGED MYOTIS									9						5	6		8		
	BIG BROWN BAT									9						5	6		8		
	YUMA MYOTIS									9						5	6		8		
100	WHITE-THROATED SWIFT									9						5	6				
	BRAZILIAN FREE-TAILED BAT									9						5	6				
	WESTERN PIPISTRELLE									9						5	6				
	SPOTTED BAT									9						5	6				
	CAVE MYOTIS									9						5	6				
	TOWNSEND'S BIG-EARED BAT									9						5	6				
	CALIFORNIA MYOTIS									9						5	6				
101	ROUGH-WINGED SWALLOW									9						5					
102	CLIFF SWALLOW									9							6				
103	VIOLET-GREEN SWALLOW									9									8		
104	BLACK SWIFT									9											10
	BARN SWALLOW									9											10
	HOARY BAT									9											10
	VAUX'S SWIFT									9											10
	TREE SWALLOW									9											10
105	BARN OWL										10					5	6		8		
106	LONG-EARED OWL										10									9	
	DOUBLE-CRESTED CORMORANT										10									9	

Table 10. Effects of habitat alterations on primary consumer and secondary consumer guilds in cottonwood-willow riparian habitats (total of 169 guilds).

Impacted guilds	Impacted system or layer of habitat				
	Aquatic	Understory	Midstory	Tree bole	Overstory
Deleterious impacts					
Primary consumers[a]	1, 4-10, 16	2, 10, 14, 24, 32, 44, 49-55	46, 59, 62	35, 60, 63	36
Secondary consumers[b]	2, 7-12, 15, 17-18, 32, 36, 82-83	4, 16, 18-19, 31, 34, 45, 74, 82-90, 97	47, 63, 75, 94	48, 59, 64, 69 95, 103	25, 52, 106
Totals	23 guilds (27 species)	31 guilds (61 species)	7 guilds (5 species)	9 guilds (12 species)	4 guilds (5 species)
Adverse impacts					
Primary consumers[a]	2-3, 11-15	1, 3, 11-13, 15, 17-23, 25-31, 33-43, 45-48, 57	11, 12, 17-19, 22-45, 47, 51-52, 56-58, 60-61	17, 22-27, 29-30, 33, 41, 45, 53, 56	11, 17-18, 22-35, 37, 41-42, 45, 48, 51, 53, 56-61
Secondary consumers[b]	1, 3-6, 13-14, 16, 19-31, 33-35	c	5, 13, 20, 23-30, 37-38, 41-46, 48-62, 64-74, 76, 79-80, 86-87, 91-93, 95-98	10, 13, 23-25, 37, 41-47, 49-55, 61, 67, 77, 79, 88, 91-94, 96-97, 99, 105	3, 5, 13, 23-24, 29, 37, 41-51, 53, 55-65, 67-68, 72, 79-80, 86, 88, 91-96, 98
Totals	31 guilds (39 species)	36+ guilds (71+ species)	94 guilds (139 species)	47 guilds (67 species)	74 guilds (103 species)

[a]See Table 8 for a list of species in each identified primary consumer guild.

[b]See Table 9 for a list of species in each identified secondary consumer guild.

[c]Additional guilds of secondary consumers will be adversely affected because of changes in their food chains due to the reduced bomass of primary consumers.

Creosote Bush-White Bursage Habitat

Creosote bush -white bursage habitat (Kuchler 1964; PNVT 42, creosote bush-bursage) occurs over the western 20% of the Hualapai-Aquarius planning unit. This habitat type provides three layers of wildlife habitat: a midstory with limited vegetative cover; an understory with limited vegetative cover on a substrate of coarse sand or small rocks (Jones 1981); and a subsurface layer. Note the guild blocks used by wildlife in this habitat type (Fig. 13). One hundred and forty vertebrate species potentially use this community as feeding and/or breeding habitat (Appendix II). These species are arrayed into 17 guilds of primary consumers (Table 11) and 27 guilds of secondary consumers (Table 12).

Grazing is limited in this habitat type where creosote bush (Larrea tridentata) and white bursage (Ambrosia dumosa) dominate because of the light herbage production. Excessive pressure on the surface vegetation will deleteriously affect seven guilds of primary consumers and eleven guilds of secondary consumers (Table 13). Eight additional guilds of primary consumers will be adversely affected. Other secondary consumers will also be affected because limited production of surface vegetation reduces the biomass of primary consumers.

Elimination of the limited midstory cover in this vegetative community will deleteriously affect three guilds of primary consumers and two guilds of secondary consumers. Eight guilds of primary consumers and 10 guilds of secondary consumers will be adversely impacted (Table 13).

The best management of this habitat for wildlife is to maintain the vegetative structure and to limit the use of current vegetation so as not to reduce the productivity of the surface and midstory layers.

Table 11. Wildlife guilds of primary consumers in creosote bush-white bursage habitats in westcentral Arizona. The interpretation of the table is as in Table 5.

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
1	COYOTE				4	5	6									5	6				
	CACTUS MOUSE				4	5	6									5	6				
2	COLLARED PECCARY				4	5	6														10
3	STRIPED SKUNK				4	5										5	6				
4	BOTTA'S POCKET GOPHER				4	5										5					
5	WHITE-THROATED WOODRAT					5	6									5	6	7			
6	DESERT IGUANA					5	6									5					
	HARRIS' ANTELOPE SQUIRREL					5	6									5					
	ROUND-TAILED GROUND SQUIRREL					5	6									5					
7	BROWN-HEADED COWBIRD					5	6										6	7			
	WESTERN HARVEST MOUSE					5	6										6	7			
	CURVE-BILLED THRASHER					5	6										6	7			
	CACTUS WREN					5	6										6	7			
	BENDIRE'S THRASHER					5	6										6	7			
	COSTA'S HUMMINGBIRD					5	6										6	7			
	HOUSE FINCH					5	6										6	7			
	MOCKINGBIRD					5	6										6	7			
8	BURRO					5	6										6				
	ROCK SQUIRREL					5	6										6				
	CATTLE					5	6										6				
	PRONGHORN					5	6										6				
9	LESSER GOLDFINCH					5	6														10
	SAGE THRASHER					5	6														10
	BREWER'S BLACKBIRD					5	6														10
	BLACK-CHINNED HUMMINGBIRD					5	6														10
	MULE DEER					5	6														10
	LADDER-BACKED WOODPECKER					5	6														10
	ANNA'S HUMMINGBIRD					5	6														10
	STARLING					5	6														10
	BIGHORN SHEEP					5	6														10
	MOUNTAIN BLUEBIRD					5	6														10
	GREAT-TAILED GRACKLE					5	6														10
	YELLOW-HEADED BLACKBIRD					5	6														10
	COMMON FLICKER					5	6														10
	RED-WINGED BLACKBIRD					5	6														10
	GRAY FOX					5	6														10
	WESTERN KINGBIRD					5	6														10
	YELLOW-RUMPED WARBLER					5	6														10

Table 11. (concluded).

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
10	ARIZONA WOODRAT					5										5	6				
	DESERT SPINY LIZARD					5										5	6				
	WESTERN SPOTTED SKUNK					5										5	6				
	CANYON MOUSE					5										5	6				
11	KIT FOX					5										5					
	SOUTHERN GRASSHOPPER MOUSE					5										5					
	DESERT POCKET MOUSE					5										5					
	MERRIAM'S KANGAROO RAT					5										5					
	ARIZONA POCKET MOUSE					5										5					
12	MOURNING DOVE					5											6	7			
13	BLACK-TAILED JACK RABBIT					5											6				
	ROCK DOVE					5											6				
	HOUSE MOUSE					5											6				
	WESTERN MEADOWLARK					5											6				
	COMMON RAVEN					5											6				
	HORNED LARK					5											6				
	DESERT COTTONTAIL					5											6				
	GAMBEL'S QUAIL					5											6				
14	BLACK-THROATED SPARROW					5												7			
15	CHIPPING SPARROW					5															10
	DARK-EYED JUNCO					5															10
	WHITE-CROWNED SPARROW					5															10
	SAGE SPARROW					5															10
	SAVANNAH SPARROW					5															10
	LARK BUNTING					5															10
	LARK SPARROW					5															10
	BREWER'S SPARROW					5															10
	WATER PIPIT					5															10
16	SAY'S PHOEBE						6									5	6				
17	ASH-THROATED FLYCATCHER						6														10
	VERDIN						6														10
	PHAINOPEPLA						6														10
	WIED'S CRESTED FLYCATCHER						6														10
	RUBY-CROWNED KINGLET						6														10

Table 12. Wildlife guilds of secondary consumers in creosote bush-white bursage habitats in westcentral Arizona. The interpretation of the table is as in Table 5.

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
1	GOPHER SNAKE				4	5	6									5	6				
	COYOTE				4	5	6									5	6				
2	GLOSSY SNAKE				4	5										5	6				
	WESTERN PATCH-NOSED SNAKE				4	5										5	6				
	STRIPED SKUNK				4	5										5	6				
	WESTERN GROUND SNAKE				4	5										5	6				
	LONG-NOSED SNAKE				4	5										5	6				
3	WESTERN SHOVEL-NOSE SNAKE				4	5										5					
	BADGER				4	5										5					
	KIT FOX				4	5										5					
4	COLLARED PECCARY				4	5															10
5	GREAT HORNED OWL					5	6			9						5	6				
	CALIFORNIA LEAF-NOSED BAT					5	6			9						5	6				
	PALLID BAT					5	6			9						5	6				
6	COSTA'S HUMMINGBIRD					5	6			9							6	7			
	BLACK-TAILED GNATCATCHER					5	6			9							6	7			
7	AMERICAN KESTREL					5	6			9							6				
8	BREWER'S BLACKBIRD					5	6			9											10
	LUCY'S WARBLER					5	6			9											10
	BLUE-GRAY GNATCATCHER					5	6			9											10
	LADDER-BACKED WOODPECKER					5	6			9											10
	COMMON FLICKER					5	6			9											10
	WIED'S CRESTED FLYCATCHER					5	6			9											10
	YELLOW-RUMPED WARBLER					5	6			9											10
	ASH-THROATED FLYCATCHER					5	6			9											10
	MOUNTAIN BLUEBIRD					5	6			9											10
	LOGGERHEAD SHRIKE					5	6			9											10
	RUBY-CROWNED KINGLET					5	6			9											10
	RED-WINGED BLACKBIRD					5	6			9											10
	YELLOW-HEADED BLACKBIRD					5	6			9											10
	STARLING					5	6			9											10
	BLACK-CHINNED HUMMINGBIRD					5	6			9											10
	ANNA'S HUMMINGBIRD					5	6			9											10

Table 12. (continued).

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
9	COACHWHIP					5	6									5	6				
	ROCK WREN					5	6									5	6				
	CANYON WREN					5	6									5	6				
	BANDED GECKO					5	6									5	6				
	CALIFORNIA KING SNAKE					5	6									5	6				
	DESERT SPINY LIZARD					5	6									5	6				
10	BENDIRE'S THRASHER					5	6										6	7			
	CACTUS WREN					5	6										6	7			
	WESTERN HARVEST MOUSE					5	6										6	7			
	CURVE-BILLED THRASHER					5	6										6	7			
	BROWN-HEADED COWBIRD					5	6										6	7			
	MOCKINGBIRD					5	6										6	7			
11	TREE LIZARD					5	6										6				
	COMMON RAVEN					5	6										6				
	LONG-TAIL BRUSH LIZARD					5	6										6				
12	GREAT-TAILED GRACKLE					5	6														10
	BOBCAT					5	6														10
	COOPER'S HAWK					5	6														10
	SHARP-SHINNED HAWK					5	6														10
	MOUNTAIN LION					5	6														10
	SCREECH OWL					5	6														10
	SAGE THRASHER					5	6														10
13	SAY'S PHOEBE					5				9						5	6				
14	LESSER NIGHTHAWK					5				9							6				
	WESTERN MEADOWLARK					5				9							6				
15	WESTERN KINGBIRD					5				9											10
	NORTHERN HARRIER					5				9											10
16	COUCH'S SPADEFOOT TOAD					5							1								

Table 12. (continued).

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
17	GREATER EARLESS LIZARD					5										5	6				
	ZEBRA-TAILED LIZARD					5										5	6				
	SIDEWINDER					5										5	6				
	WESTERN SPOTTED SKUNK					5										5	6				
	CANYON MOUSE					5										5	6				
	CACTUS MOUSE					5										5	6				
	MOHAVE RATTLESNAKE					5										5	6				
	WESTERN DIAMONDBACK RATTLESNAKE					5										5	6				
	SIDE-BLOTCHED LIZARD					5										5	6				
	NIGHT SNAKE					5										5	6				
	BARN OWL					5										5	6				
18	MERRIAM'S KANGAROO RAT					5										5					
	DESERT IGUANA					5										5					
	BURROWING OWL					5										5					
	SOUTHERN GRASSHOPPER MOUSE					5										5					
	HARRIS' ANTELOPE SQUIRREL					5										5					
	ROUND-TAILED GROUND SQUIRREL					5										5					
19	ROADRUNNER					5											6	7			
20	HOUSE MOUSE					5											6				
	SPOTTED LEAF-NOSE SNAKE					5											6				
	PRAIRIE FALCON					5											6				
	TURKEY VULTURE					5											6				
	DESERT HORNED LIZARD					5											6				
	GAMBEL'S QUAIL					5											6				
	HORNED LARK					5											6				
	CALIFORNIA WHIPTAIL					5											6				
	REGAL HORNED LIZARD					5											6				
	ROCK SQUIRREL					5											6				
	GOLDEN EAGLE					5											6				
21	RED-TAILED HAWK					5												7			
	BLACK-THROATED SPARROW					5												7			

Table 12. (concluded).

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
22	GRAY FOX					5															10
	WATER PIPIT					5															10
	RED-SPOTTED TOAD					5															10
	MOUNTAIN PLOVER					5															10
	LARK BUNTING					5															10
	BREWER'S SPARROW					5															10
	DARK-EYED JUNCO					5															10
	LONG-BILLED CURLEW					5															10
	LONG-EARED OWL					5															10
	CHIPPING SPARROW					5															10
	WHITE-CROWNED SPARROW					5															10
	SAVANNAH SPARROW					5															10
	BLACK-NECKED GARTER SNAKE					5															10
	LARK SPARROW					5															10
	CHECKERED GARTER SNAKE					5															10
	SAGE SPARROW					5															10
23	VERDIN						6														10
	PHAINOPEPLA						6														10
24	WHITE-THROATED SWIFT									9						5	6				
	BIG BROWN BAT									9						5	6				
	BRAZILIAN FREE-TAILED BAT									9						5	6				
	CALIFORNIA MYOTIS									9						5	6				
	CAVE MYOTIS									9						5	6				
	WESTERN PIPISTRELLE									9						5	6				
	TOWNSEND'S BIG-EARED BAT									9						5	6				
25	ROUGH-WINGED SWALLOW									9						5					
26	CLIFF SWALLOW									9							6				
27	VIOLET-GREEN SWALLOW									9											10
	BARN SWALLOW									9											10
	BLACK SWIFT									9											10
	TREE SWALLOW									9											10
	VAUX'S SWIFT									9											10

Table 13. Effects of habitat alterations on primary consumer and secondary consumer guilds in creosote bush-white bursage habitats (total of 44 guilds).

Impacted guilds	Impacted system or layer of habitat				
	Aquatic	Understory	Midstory	Tree bole	Overstory
Deleterious impacts					
Primary consumers[a]		8, 10-15	14, 16, 17		
Secondary consumers[b]		7, 11, 14, 16-22	21, 23		
Totals		17 guilds (66 species)	5 guilds (8 species)		
Adverse impacts					
Primary consumers[a]		1-7, 9	1-2, 5-9, 12		
Secondary consumers[b]		c	1, 5-12, 19		
Totals		8+ guilds (34+ species)	18 guilds (64 species)		

[a]See Table 11 for a list of species in each identified primary consumer guild.

[b]See Table 12 for a list of species in each identified secondary consumer guild.

[c]Additional guilds of secondary consumers will be adversely affected because of changes in their food chains due to the reduced biomass of primary consumers.

Desert Grassland Habitat

Desert grassland habitats frequently contain only surface vegetation less than 0.5 m in height; these habitats provide only subsurface and surface layers as habitat. Note the guild blocks used by wildlife in this habitat type (Fig. 11). Vegetative cover, grass (e.g., Bouteloua spp.), forbs, or half shrubs [e.g., snakeweed (Gutierrezia spp.)], varies in density and percent surface cover in response to land-use practices. Desert grasslands occur on lands mapped by Kuchler (1964) as PNVT 23 (juniper-pinyon woodland) in the area near the Hualapai Mountains and as PNVT 58 (grama-tobossa-shrubsteppe) in the northeastern portion of the planning units. Desert grasslands cover about 8% of the westcentral Arizona study area and are potential feeding and/or breeding habitats for 136 vertebrate species (Appendix II), arrayed into seven guilds of primary consumers (Table 14) and 15 guilds of secondary consumers (Table 15).

Heavy grazing or other land uses that severely reduce surface vegetation will deleteriously affect four guilds of primary consumers and adversely affect the other three guilds of primary consumers (Table 16). In addition, five guilds of secondary consumers will be deleteriously affected. Reduction in the numbers of primary consumers in desert grassland habitats, related to the reduction in surface vegetation, will also modify food chains and impact other guilds of secondary consumers.

The best management policy for wildlife in desert grassland habitats is to restrict livestock use of surface vegetation to that portion of current annual growth that can be removed without adversely impacting the structure of the vegetative community over time.

Table 14. Wildlife guilds of primary consumers in desert grassland habitats in westcentral Arizona. The interpretation of the table is as in Table 5.

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
1	COYOTE				4	5										5	6				
	CACTUS MOUSE				4	5										5	6				
	DEER MOUSE				4	5										5	6				
	STRIPED SKUNK				4	5										5	6				
2	BOTTA'S POCKET GOPHER				4	5										5					
3	COLLARED PECCARY				4	5															10
4	WHITE-THROATED WOODRAT					5										5	6				
	STEPHENS' WOODRAT					5										5	6				
	WESTERN SPOTTED SKUNK					5										5	6				
	BIGHORN SHEEP					5										5	6				
	CANYON MOUSE					5										5	6				
	ARIZONA WOODRAT					5										5	6				
	DESERT SPINY LIZARD					5										5	6				
5	NORTHERN GRASSHOPPER MOUSE					5										5					
	DESERT POCKET MOUSE					5										5					
	SILKY POCKET MOUSE					5										5					
	ARIZONA POCKET MOUSE					5										5					
	HARRIS' ANTELOPE SQUIRREL					5										5					
	MERRIAM'S KANGAROO RAT					5										5					
	BAILEY'S POCKET MOUSE					5										5					
	SOUTHERN GRASSHOPPER MOUSE					5										5					
	ORD'S KANGAROO RAT					5										5					
6	EASTERN COTTONTAIL					5											6				
	BURRO					5											6				
	CACTUS WREN					5											6				
	WESTERN MEADOWLARK					5											6				
	COMMON RAVEN					5											6				
	ROCK SQUIRREL					5											6				
	HOUSE MOUSE					5											6				
	MOURNING DOVE					5											6				
	COSTA'S HUMMINGBIRD					5											6				
	BLACK-TAILED JACK RABBIT					5											6				
	CATTLE					5											6				
	PRONGHORN					5											6				
	DESERT COTTONTAIL					5											6				
	HORNED LARK					5											6				
	ROCK DOVE					5											6				
	MOCKINGBIRD					5											6				
	WESTERN HARVEST MOUSE					5											6				
	BROWN-HEADED COWBIRD					5											6				
	GAMBEL'S QUAIL					5											6				
	CURVE-BILLED THRASHER					5											6				
	MULE DEER					5											6				

Table 14. (concluded).

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
7	CHESTNUT-COLLARED LONGSPUR					5															10
	WHITE-CROWNED SPARROW					5															10
	LADDER-BACKED WOODPECKER					5															10
	STARLING					5															10
	BREWER'S SPARROW					5															10
	AMERICAN ROBIN					5															10
	SAGE SPARROW					5															10
	SAVANNAH SPARROW					5															10
	LARK BUNTING					5															10
	LARK SPARROW					5															10
	COMMON FLICKER					5															10
	EASTERN MEADOWLARK					5															10
	SCRUB JAY					5															10
	BUSHTIT					5															10
	BLACK-CHINNED HUMMINGBIRD					5															10
	AMERICAN GOLDFINCH					5															10
	CASSIN'S KINGBIRD					5															10
	MOUNTAIN BLUEBIRD					5															10
	WESTERN KINGBIRD					5															10
	HOUSE FINCH					5															10
	SAGE THRASHER					5															10
	GRAY FOX					5															10
	SCOTT'S ORIOLE					5															10
	WATER PIPIT					5															10
	COMMON CROW					5															10
	ANNA'S HUMMINGBIRD					5															10
	YELLOW-RUMPED WARBLER					5															10
	LESSER GOLDFINCH					5															10
	VESPER SPARROW					5															10

Table 15. Wildlife guilds of secondary consumers in desert grassland habitats in westcentral Arizona. The interpretation of the table is as in Table 5.

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
1	GLOSSY SNAKE				4	5										5	6				
	GILBERT'S SKINK				4	5										5	6				
	COYOTE				4	5										5	6				
	WESTERN GROUND SNAKE				4	5										5	6				
	STRIPED SKUNK				4	5										5	6				
2	BADGER				4	5										5					
3	COLLARED PECCARY				4	5															10
4	SMALL-FOOTED MYOTIS					5				9						5	6				
	FRINGED MYOTIS					5				9						5	6				
	SAY'S PHOEBE					5				9						5	6				
	PALLID BAT					5				9						5	6				
	GREAT HORNED OWL					5				9						5	6				
5	WESTERN MEADOWLARK					5				9							6				
	LESSER NIGHTHAWK					5				9							6				
	COSTA'S HUMMINGBIRD					5				9							6				
	AMERICAN KESTREL					5				9							6				
6	CASSIN'S KINGBIRD					5				9											10
	MOUNTAIN BLUEBIRD					5				9											10
	COMMON FLICKER					5				9											10
	RUBY-CROWNED KINGLET					5				9											10
	ASH-THROATED FLYCATCHER					5				9											10
	NORTHERN HARRIER					5				9											10
	MERLIN					5				9											10
	ANNA'S HUMMINGBIRD					5				9											10
	BLUE-GRAY GNATCATCHER					5				9											10
	LADDER-BACKED WOODPECKER					5				9											10
	YELLOW-RUMPED WARBLER					5				9											10
	BLACK-CHINNED HUMMINGBIRD					5				9											10
	STARLING					5				9											10
	SCOTT'S ORIOLE					5				9											10
	EASTERN MEADOWLARK					5				9											10
	WESTERN KINGBIRD					5				9											10
	LUCY'S WARBLER					5				9											10
7	COUCH'S SPADEFOOT TOAD					5						1									

Table 15. (continued).

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
8	SONORA WHIPSNAKE					5										5	6				
	COLLARED LIZARD					5										5	6				
	CANYON MOUSE					5										5	6				
	ARIZONA BLACK RATTLESNAKE					5										5	6				
	ZEBRA-TAILED LIZARD					5										5	6				
	GREATER EARLESS LIZARD					5										5	6				
	CANYON WREN					5										5	6				
	CACTUS MOUSE					5										5	6				
	BARN OWL					5										5	6				
	WESTERN SPOTTED SKUNK					5										5	6				
	ROCK WREN					5										5	6				
	DESERT SPINY LIZARD					5										5	6				
	DEER MOUSE					5										5	6				
9	SOUTHERN GRASSHOPPER MOUSE					5										5					
	NORTHERN GRASSHOPPER MOUSE					5										5					
	MERRIAM'S KANGAROO RAT					5										5					
	BURROWING OWL					5										5					
	HARRIS' ANTELOPE SQUIRREL					5										5					
10	GAMBEL'S QUAIL					5											6				
	TREE LIZARD					5											6				
	WESTERN HARVEST MOUSE					5											6				
	MOCKINGBIRD					5											6				
	PLATEAU WHIPTAIL					5											6				
	CURVE-BILLED THRASHER					5											6				
	BROWN-HEADED COWBIRD					5											6				
	HORNED LARK					5											6				
	PRAIRIE FALCON					5											6				
	CALIFORNIA WHIPTAIL					5											6				
	CHIHUAHUAN WHIPTAIL					5											6				
	ROCK SQUIRREL					5											6				
	SOUTHERN PLATEAU LIZARD					5											6				
	TURKEY VULTURE					5											6				
	GOLDEN EAGLE					5											6				
	CACTUS WREN					5											6				
	HOUSE MOUSE					5											6				
	COMMON RAVEN					5											6				
	ROADRUNNER					5											6				

Table 15. (concluded).

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
11	LONG-EARED OWL					5															10
	CHESTNUT-COLLARED LONGSPUR					5															10
	AMERICAN ROBIN					5															10
	ZONE-TAILED HAWK					5															10
	SAGE THRASHER					5															10
	LARK BUNTING					5															10
	SAVANNAH SPARROW					5															10
	GRAY FOX					5															10
	COMMON CROW					5															10
	COOPER'S HAWK					5															10
	LARK SPARROW					5															10
	WATER PIPIT					5															10
	SCRUB JAY					5															10
	VESPER SPARROW					5															10
	FERRUGINOUS HAWK					5															10
	SAGE SPARROW					5															10
	RED-TAILED HAWK					5															10
	MOUNTAIN LION					5															10
	LONG-BILLED CURLEW					5															10
	BREWER'S SPARROW					5															10
	MOUNTAIN PLOVER					5															10
	BALD EAGLE					5															10
	LOGGERHEAD SHRIKE					5															10
	BOBCAT					5															10
	WHITE-CROWNED SPARROW					5															10
12	TOWNSEND'S BIG-EARED BAT									9						5	6				
	WHITE-THROATED SWIFT									9						5	6				
	BRAZILIAN FREE-TAILED BAT									9						5	6				
	CAVE MYOTIS									9						5	6				
	BIG BROWN BAT									9						5	6				
	CALIFORNIA MYOTIS									9						5	6				
	SPOTTED BAT									9						5	6				
	YUMA MYOTIS									9						5	6				
	LONG-LEGGED MYOTIS									9						5	6				
	WESTERN PIPISTRELLE									9						5	6				
13	ROUGH-WINGED SWALLOW									9						5					
14	CLIFF SWALLOW									9							6				
15	BARN SWALLOW									9											10
	TREE SWALLOW									9											10
	VAUX'S SWIFT									9											10
	VIOLET-GREEN SWALLOW									9											10
	BLACK SWIFT									9											10

Table 16. Effects of habitat alterations on primary consumer and secondary consumer guilds in desert grassland habitats (total of 22 guilds).

Impacted guilds	Impacted system or layer of habitat				
	Aquatic	Understory	Midstory	Tree bole	Overstory
Deleterious impacts					
Primary consumers[a]		4-7			
Secondary consumers[b]		5, 8-11			
Totals		9 guilds (98 species)			
Adverse impacts					
Primary consumers[a]		1-3			
Secondary consumers[b]		c			
Totals		3+ guilds (6+ species)			

[a]See Table 14 for a list of species in each identified primary consumer guild.

[b]See Table 15 for a list of species in each identified secondary consumer guild.

[c]Additional guilds of secondary consumers will be adversely affected because of changes in their food chains due to the reduced biomass of primary consumers.

Joshua Tree-Creosote Bush Habitat

This habitat type occurs in a zone where creosote bush (Kuchler 1964; PNVT 42, creosote bush-bursage) occurs at the highest elevations in its range and the shrubsteppe community (Kuchler 1964; PNVT 58, grama-tobosa shrubsteppe) occurs at the lowest elevations in its range. Joshua tree-creosote bush habitat is present in the western portion of the planning units and covers about 3% of the study area (U.S. Bureau of Land Management 1980). There are three layers of habitat: a subsurface; a thin surface cover; and a midstory varying from flatlands with an extensive cover of creosote bushes with scattered joshua trees (Yucca brevifolia) to dense stands of joshua trees with creosote bushes in the lower midstory.

One hundred and forty-eight vertebrate species potentially use this habitat for breeding and/or feeding (Appendix II). The wildlife species are arrayed into 21 guilds of primary consumers (Table 17) and 32 guilds of secondary consumers (Table 18).

Heavy grazing of the limited surface vegetation in this habitat type will deleteriously affect seven guilds of primary consumers and eight guilds of secondary consumers (Table 19). In addition, 12 guilds of primary consumers will be adversely affected. Other guilds of secondary consumers will also be adversely affected if the excessive removal of the limited surface vegetation modifies food chains because of the reduction in biomass of primary consumers.

Extensive removal of the midstory component in joshua tree-creosote bush habitats will deleteriously affect five guilds of primary consumers and six guilds of secondary consumers. Eight guilds of primary consumers and nine guilds of secondary consumers (Table 19) will be adversely affected.

The best management of this habitat for wildlife involves restricting the use of current vegetation to levels that will not deleteriously affect the structure of the habitat layers present in this community. Joshua trees should be protected because of their aesthetically and botanically unique characteristics.

Table 17. Wildlife guilds of primary consumers in joshua tree-creosote bush habitats in westcentral Arizona. The interpretation of the table is as in Table 5.

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
1	CACTUS MOUSE				4	5	6									5	6				
	COYOTE				4	5	6									5	6				
2	COLLARED PECCARY				4	5	6														10
3	STRIPED SKUNK				4	5										5	6				
4	BOTTA'S POCKET GOPHER				4	5										5					
5	WHITE-THROATED WOODRAT					5	6									5	6	7			
6	GRAY FOX					5	6									5	6				
7	COMMON FLICKER					5	6									5		7			
8	HARRIS' ANTELOPE SQUIRREL					5	6									5					
	ROUND-TAILED GROUND SQUIRREL					5	6									5					
	STARLING					5	6									5					
	DESERT IGUANA					5	6									5					
9	HOUSE FINCH					5	6										6	7			
	MOCKINGBIRD					5	6										6	7			
	BENDIRE'S THRASHER					5	6										6	7			
	BROWN-HEADED COWBIRD					5	6										6	7			
	COSTA'S HUMMINGBIRD					5	6										6	7			
	CACTUS WREN					5	6										6	7			
	WESTERN HARVEST MOUSE					5	6										6	7			
	CURVE-BILLED THRASHER					5	6										6	7			
10	PRONGHORN					5	6										6				
	ROCK SQUIRREL					5	6										6				
	BURRO					5	6										6				
	CATTLE					5	6										6				
11	WESTERN KINGBIRD					5	6											7			
	GILA WOODPECKER					5	6											7			
	LADDER-BACKED WOODPECKER					5	6											7			
	SCOTT'S ORIOLE					5	6											7			

Table 17. (continued).

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
12	YELLOW-RUMPED WARBLER					5	6														10
	WESTERN BLUEBIRD					5	6														10
	MOUNTAIN BLUEBIRD					5	6														10
	SAGE THRASHER					5	6														10
	MULE DEER					5	6														10
	BLACK-CHINNED HUMMINGBIRD					5	6														10
	HERMIT THRUSH					5	6														10
	LEWIS' WOODPECKER					5	6														10
	ANNA'S HUMMINGBIRD					5	6														10
	BLACK-HEADED GROSBEAK					5	6														10
	RUBY-CROWNED KINGLET					5	6														10
	BUSHTIT					5	6														10
	BIGHORN SHEEP					5	6														10
	SWAINSON'S THRUSH					5	6														10
	LESSER GOLDFINCH					5	6														10
13	WESTERN SPOTTED SKUNK					5										5	6				
	CANYON MOUSE					5										5	6				
	DESERT SPINY LIZARD					5										5	6				
	ARIZONA WOODRAT					5										5	6				
14	SOUTHERN GRASSHOPPER MOUSE					5										5					
	DESERT POCKET MOUSE					5										5					
	ROCK POCKET MOUSE					5										5					
	KIT FOX					5										5					
	MERRIAM'S KANGAROO RAT					5										5					
	DESERT TORTOISE					5										5					
	ARIZONA POCKET MOUSE					5										5					
15	MOURNING DOVE					5											6	7			
16	DESERT COTTONTAIL					5											6				
	BLACK-TAILED JACK RABBIT					5											6				
	COMMON RAVEN					5											6				
	GAMBEL'S QUAIL					5											6				
	CHUCKWALLA					5											6				
	ROCK DOVE					5											6				
	HOUSE MOUSE					5											6				
17	BROWN TOWHEE					5												7			
	BLACK-THROATED SPARROW					5												7			

Table 17. (concluded).

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
18	WHITE-CROWNED SPARROW					5															10
	LARK SPARROW					5															10
	DARK-EYED JUNCO					5															10
	CHIPPING SPARROW					5															10
	BREWER'S SPARROW					5															10
	SAGE SPARROW					5															10
	WATER PIPIT					5															10
19	SAY'S PHOEBE						6									5	6				
20	PHAINOPEPLA						6											7			
	ASH-THROATED FLYCATCHER						6											7			
	VERDIN						6											7			
21	NORTHERN ORIOLE						6														10
	HOODED ORIOLE						6														10
	WIED'S CRESTED FLYCATCHER						6														10

Table 18. Wildlife guilds of secondary consumers in joshua tree-creosote bush habitats in westcentral Arizona. The interpretation of the table is as in Table 5.

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
1	GOPHER SNAKE				4	5	6									5	6				
	COYOTE				4	5	6									5	6				
2	GLOSSY SNAKE				4	5										5	6				
	WESTERN PATCH-NOSED SNAKE				4	5										5	6				
	WESTERN GROUND SNAKE				4	5										5	6				
	STRIPED SKUNK				4	5										5	6				
	LONG-NOSED SNAKE				4	5										5	6				
3	KIT FOX				4	5										5					
4	COLLARED PECCARY				4	5															10
5	CALIFORNIA LEAF-NOSED BAT					5	6			9						5	6				
	PALLID BAT					5	6			9						5	6				
	GREAT HORNED OWL					5	6			9						5	6				
6	COMMON FLICKER					5	6			9						5		7			
7	STARLING					5	6			9						5					
8	COSTA'S HUMMINGBIRD					5	6			9							6	7			
	BLACK-TAILED GNATCATCHER					5	6			9							6	7			
9	LADDER-BACKED WOODPECKER					5	6			9								7			
	ASH-THROATED FLYCATCHER					5	6			9								7			
	SCOTT'S ORIOLE					5	6			9								7			
	GILA WOODPECKER					5	6			9								7			

Table 18. (continued).

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
10	SWAINSON'S THRUSH					5	6			9											10
	WILSON'S WARBLER					5	6			9											10
	WESTERN BLUEBIRD					5	6			9											10
	HAMMOND'S FLYCATCHER					5	6			9											10
	MOUNTAIN BLUEBIRD					5	6			9											10
	ANNA'S HUMMINGBIRD					5	6			9											10
	RUBY-CROWNED KINGLET					5	6			9											10
	DUSKY FLYCATCHER					5	6			9											10
	BLACK-CHINNED HUMMINGBIRD					5	6			9											10
	WILLOW FLYCATCHER					5	6			9											10
	LEWIS' WOODPECKER					5	6			9											10
	HOODED ORIOLE					5	6			9											10
	GRAY FLYCATCHER					5	6			9											10
	BLUE-GRAY GNATCATCHER					5	6			9											10
	NORTHERN ORIOLE					5	6			9											10
	YELLOW-RUMPED WARBLER					5	6			9											10
	WIED'S CRESTED FLYCATCHER					5	6			9											10
	LEAST FLYCATCHER					5	6			9											10
	LUCY'S WARBLER					5	6			9											10
	WESTERN FLYCATCHER					5	6			9											10
11	DESERT SPINY LIZARD					5	6									5	6				
	BANDED GECKO					5	6									5	6				
	CANYON WREN					5	6									5	6				
	CALIFORNIA KING SNAKE					5	6									5	6				
	BOBCAT					5	6									5	6				
	COACHWHIP					5	6									5	6				
	ROCK WREN					5	6									5	6				
12	CURVE-BILLED THRASHER					5	6										6	7			
	BROWN-HEADED COWBIRD					5	6										6	7			
	BENDIRE'S THRASHER					5	6										6	7			
	MOCKINGBIRD					5	6										6	7			
	WESTERN HARVEST MOUSE					5	6										6	7			
	CACTUS WREN					5	6										6	7			
13	COMMON RAVEN					5	6										6				
	AMERICAN KESTREL					5	6										6				
	LONG-TAIL BRUSH LIZARD					5	6										6				
14	SCREECH OWL					5	6											7			
	LOGGERHEAD SHRIKE					5	6											7			

Table 18. (continued).

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
15	COOPER'S HAWK					5	6														10
	BEWICK'S WREN					5	6														10
	HERMIT THRUSH					5	6														10
	SAGE THRASHER					5	6														10
	SHARP-SHINNED HAWK					5	6														10
	MACGILLIVRAY'S WARBLER					5	6														10
	MOUNTAIN LION					5	6														10
	BLACK-HEADED GROSBEAK					5	6														10
16	SAY'S PHOEBE					5				9						5	6				
17	LESSER NIGHTHAWK					5				9							6				
18	WESTERN KINGBIRD					5				9								7			
19	POOR-WILL					5				9											10
20	SIDE-BLOTCHED LIZARD					5										5	6				
	CACTUS MOUSE					5										5	6				
	CANYON MOUSE					5										5	6				
	GREATER EARLESS LIZARD					5										5	6				
	NIGHT SNAKE					5										5	6				
	ZEBRA-TAILED LIZARD					5										5	6				
	WESTERN SPOTTED SKUNK					5										5	6				
	WESTERN DIAMONDBACK RATTLESNAKE					5										5	6				
	MOHAVE RATTLESNAKE					5										5	6				
	GRAY FOX					5										5	6				
21	DESERT IGUANA					5										5					
	MERRIAM'S KANGAROO RAT					5										5					
	ROUND-TAILED GROUND SQUIRREL					5										5					
	HARRIS' ANTELOPE SQUIRREL					5										5					
	SOUTHERN GRASSHOPPER MOUSE					5										5					
22	ROADRUNNER					5											6	7			
23	TURKEY VULTURE					5											6				
	ROCK SQUIRREL					5											6				
	HOUSE MOUSE					5											6				
	GAMBEL'S QUAIL					5											6				
	SPOTTED LEAF-NOSE SNAKE					5											6				
	REGAL HORNED LIZARD					5											6				
	DESERT HORNED LIZARD					5											6				
	GOLDEN EAGLE					5											6				
	CALIFORNIA WHIPTAIL					5											6				
	PRAIRIE FALCON					5											6				
	RED-TAILED HAWK					5											6				

Table 18. (concluded).

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
24	BROWN TOWHEE					5												7			
	BLACK-THROATED SPARROW					5												7			
25	WATER PIPIT					5															10
	BREWER'S SPARROW					5															10
	LONG-EARED OWL					5															10
	RED-SPOTTED TOAD					5															10
	SAGE SPARROW					5															10
	WHITE-CROWNED SPARROW					5															10
	CHIPPING SPARROW					5															10
	BLACK-NECKED GARTER SNAKE					5															10
	DARK-EYED JUNCO					5															10
	CHECKERED GARTER SNAKE					5															10
	LARK SPARROW					5															10
26	WESTERN TANAGER						6			9											10
27	VERDIN						6											7			
	PHAINOPEPLA						6											7			
28	BUSHTIT						6														10
	TOWNSEND'S WARBLER						6														10
29	WHITE-THROATED SWIFT									9						5	6				
	TOWNSEND'S BIG-EARED BAT									9						5	6				
	WESTERN PIPISTRELLE									9						5	6				
	CALIFORNIA MYOTIS									9						5	6				
	BRAZILIAN FREE-TAILED BAT									9						5	6				
	BIG BROWN BAT									9						5	6				
	CAVE MYOTIS									9						5	6				
30	ROUGH-WINGED SWALLOW									9						5					
31	CLIFF SWALLOW									9							6				
32	BARN SWALLOW									9											10
	VAUX'S SWIFT									9											10
	BLACK SWIFT									9											10
	VIOLET-GREEN SWALLOW									9											10
	TREE SWALLOW									9											10

Table 19. Effects of habitat alterations on primary consumer and secondary consumer guilds in joshua tree-creosote bush habitats (total of 53 guilds).

Impacted guilds	Impacted system or layer of habitat				
	Aquatic	Understory	Midstory	Tree bole	Overstory
Deleterious impacts					
Primary consumers[a]		10, 13-18	11, 17, 19-21		
Secondary consumers[b]		13, 17, 20-25	9, 14, 18, 24, 27-28		
Totals		15 guilds (59 species)	11 guilds (17 species)		
Adverse impacts					
Primary consumers[a]		1-9, 11-12, 19	1-2, 5-10, 12, 15,		
Secondary consumers[b]		c	1, 5-8, 10-13, 15-22		
Totals		12+ guilds (40+ species)	21 guilds (71 species)		

[a]See Table 17 for a list of species in each identified primary consumer guild.

[b]See Table 18 for a list of species in each identified secondary consumer guild.

[c]Additional guilds of secondary consumers will be adversely affected because of changes in their food chains due to the reduced biomass of primary consumers.

Juniper-Mixed Shrub Habitat

Juniper-mixed shrub habitat occurs in some lower elevations of the juniper-pinyon type (Kuchler 1964, PNVT 23). The juniper-mixed shrub type provides three layers of habitat for wildlife: an open and scattered juniper (Juniperus spp.) midstory canopy, occurring in a shrubland community; a variety of herbaceous species and half shrubs occurring in the understory on a terrestrial surface frequently covered by large rocks or rock outcrops (Jones 1981); and a subsurface layer. Two hundred and nine vertebrate species potentially utilize food sources and/or breeding substrates in juniper-mixed shrub habitats (Appendix II); these species are arrayed into 20 guilds of primary consumers (Table 20) and 32 guilds of secondary consumers (Table 21).

Heavy grazing in this habitat type will deleteriously impact seven guilds of primary consumers and nine guilds of secondary consumers (Table 22). Eleven additional guilds of primary consumers will be adversely impacted. Other guilds of secondary consumers will also be affected to varying degrees because of changes in their food chains caused by the reduction in primary consumers.

Extensive reduction of the midstory canopy, resulting from the use of herbicides, fire, mechanical procedures, or other causes will deleteriously impact five guilds of primary consumers and six guilds of secondary consumers. In addition, nine guilds of primary consumers and 11 guilds of secondary consumers (Table 22) will be adversely affected.

The best management of juniper-mixed shrubs habitat for wildlife involves restricting the use of current vegetation production to levels that will not deleteriously affect the structure of the habitat layers present in this community and restricting the removal of midstory vegetation by wide spread mechanical clearing or herbicidal treatments.

Table 20. Wildlife guilds of primary consumers in juniper-mixed shrub habitats in westcentral Arizona. The interpretation of the table is as in Table 5.

GUILD NO.	GUILD MEMBERS	FEEDING LOCI 1 2 3 4 5 6 7 8 9 10	BREEDING LOCI 1 2 3 4 5 6 7 8 9 10
1	COLLARED PECCARY	4 5 6	5 6
	BLACK BEAR	4 5 6	5 6
	CACTUS MOUSE	4 5 6	5 6
	PORCUPINE	4 5 6	5 6
	COYOTE	4 5 6	5 6
2	STRIPED SKUNK	4 5	5 6
3	BOTTA'S POCKET GOPHER	4 5	5
4	WHITE-THROATED WOODRAT	5 6	5 6 7
5	BIGHORN SHEEP	5 6	5 6
	STEPHENS' WOODRAT	5 6	5 6
	RINGTAIL	5 6	5 6
	GRAY FOX	5 6	5 6
	BRUSH MOUSE	5 6	5 6
6	COMMON FLICKER	5 6	5 7
7	STARLING	5 6	5
	ROUND-TAILED GROUND SQUIRREL	5 6	5
	HARRIS' ANTELOPE SQUIRREL	5 6	5
8	CRISSAL THRASHER	5 6	6 7
	CURVE-BILLED THRASHER	5 6	6 7
	HOUSE FINCH	5 6	6 7
	MOCKINGBIRD	5 6	6 7
	COSTA'S HUMMINGBIRD	5 6	6 7
	CACTUS WREN	5 6	6 7
	BROWN-HEADED COWBIRD	5 6	6 7
	WESTERN HARVEST MOUSE	5 6	6 7
9	PRONGHORN	5 6	6
	MULE DEER	5 6	6
	PINON MOUSE	5 6	6
	BURRO	5 6	6
	CATTLE	5 6	6
	ROCK SQUIRREL	5 6	6

Table 20. (continued).

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
10	WESTERN KINGBIRD					5	6											7			
	SCRUB JAY					5	6											7			
	GILA WOODPECKER					5	6											7			
	LADDER-BACKED WOODPECKER					5	6											7			
	BUSHTIT					5	6											7			
	SCOTT'S ORIOLE					5	6											7			
11	LEWIS' WOODPECKER					5	6														10
	SWAINSON'S THRUSH					5	6														10
	TOWNSEND'S SOLITAIRE					5	6														10
	AMERICAN ROBIN					5	6														10
	LAZULI BUNTING					5	6														10
	HERMIT THRUSH					5	6														10
	BLACK-HEADED GROSBEAK					5	6														10
	RUFOUS HUMMINGBIRD					5	6														10
	GREEN-TAILED TOWHEE					5	6														10
	PINON JAY					5	6														10
	MOUNTAIN BLUEBIRD					5	6														10
	BLUE GROSBEAK					5	6														10
	BROAD-TAILED HUMMINGBIRD					5	6														10
	ACORN WOODPECKER					5	6														10
	ANNA'S HUMMINGBIRD					5	6														10
	CASSIN'S KINGBIRD					5	6														10
	COMMON CROW					5	6														10
	STELLER'S JAY					5	6														10
	PINE SISKIN					5	6														10
	RUBY-CROWNED KINGLET					5	6														10
	SAGE THRASHER					5	6														10
	YELLOW-RUMPED WARBLER					5	6														10
	CALLIOPE HUMMINGBIRD					5	6														10
	BLACK-CHINNED HUMMINGBIRD					5	6														10
	AMERICAN GOLDFINCH					5	6														10
	WESTERN BLUEBIRD					5	6														10
12	CLIFF CHIPMUNK					5										5	6				
	WESTERN SPOTTED SKUNK					5										5	6				
	ARIZONA WOODRAT					5										5	6				
	DESERT SPINY LIZARD					5										5	6				
	CANYON MOUSE					5										5	6				

Table 20. (continued).

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
13	SOUTHERN GRASSHOPPER MOUSE					5										5					
	MERRIAM'S KANGAROO RAT					5										5					
	BAILEY'S POCKET MOUSE					5										5					
	DESERT TORTOISE					5										5					
	DESERT POCKET MOUSE					5										5					
	ARIZONA POCKET MOUSE					5										5					
	ROCK POCKET MOUSE					5										5					
	LEOPARD LIZARD					5										5					
	NORTHERN GRASSHOPPER MOUSE					5										5					
14	MOURNING DOVE					5											6	7			
15	COMMON RAVEN					5											6				
	ROCK DOVE					5											6				
	RUFOUS-SIDED TOWHEE					5											6				
	HOUSE MOUSE					5											6				
	RUFOUS-CROWNED SPARROW					5											6				
	CHUCKWALLA					5											6				
	DESERT COTTONTAIL					5											6				
	BLACK-TAILED JACK RABBIT					5											6				
	GAMBEL'S QUAIL					5											6				
	EASTERN COTTONTAIL					5											6				
16	BROWN TOWHEE					5												7			
	BLACK-CHINNED SPARROW					5												7			
	BLACK-THROATED SPARROW					5												7			
17	WHITE-CROWNED SPARROW					5															10
	WATER PIPIT					5															10
	BREWER'S SPARROW					5															10
	DARK-EYED JUNCO					5															10
	PURPLE FINCH					5															10
	WESTERN MEADOWLARK					5															10
	CHIPPING SPARROW					5															10
	FOX SPARROW					5															10
	TREE SWALLOW					5															10
	LARK SPARROW					5															10

Table 20. (concluded).

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
18	SAY'S PHOEBE						6									5	6				
19	PLAIN TITMOUSE						6											7			
	VERDIN						6											7			
	PHAINOPEPLA						6											7			
	ASH-THROATED FLYCATCHER						6											7			
20	YELLOW-BELLIED SAPSUCKER						6														10
	WARBLING VIREO						6														10
	HOODED ORIOLE						6														10
	WIED'S CRESTED FLYCATCHER						6														10
	NORTHERN ORIOLE						6														10
	HERMIT WARBLER						6														10
	CEDAR WAXWING						6														10

Table 21. Wildlife guilds of secondary consumers in juniper-mixed shrub habitats in westcentral Arizona. The interpretation of the table is as in Table 5.

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
1	GOPHER SNAKE				4	5	6									5	6				
	STRIPED WHIPSNAKE				4	5	6									5	6				
	RINGTAIL				4	5	6									5	6				
	COYOTE				4	5	6									5	6				
2	MEXICAN BLACK-HEADED SNAKE				4	5										5	6				
	WESTERN PATCH-NOSED SNAKE				4	5										5	6				
	GLOSSY SNAKE				4	5										5	6				
	WESTERN GROUND SNAKE				4	5										5	6				
	COLLARED PECCARY				4	5										5	6				
	LONG-NOSED SNAKE				4	5										5	6				
	BLACK BEAR				4	5										5	6				
	STRIPED SKUNK				4	5										5	6				
3	GILA MONSTER				4	5										5					
	BADGER				4	5										5					
4	DESERT NIGHT LIZARD				4	5											6				
	RING-NECK SNAKE				4	5											6				
5	PALLID BAT					5	6			9						5	6				
	GREAT HORNED OWL					5	6			9						5	6				
	FRINGED MYOTIS					5	6			9						5	6				
6	COMMON FLICKER					5	6			9						5		7			
7	STARLING					5	6			9						5					
8	COSTA'S HUMMINGBIRD					5	6			9							6	7			
	BLACK-TAILED GNATCATCHER					5	6			9							6	7			
9	GRAY VIREO					5	6			9								7			
	GILA WOODPECKER					5	6			9								7			
	ASH-THROATED FLYCATCHER					5	6			9								7			
	LADDER-BACKED WOODPECKER					5	6			9								7			
	LUCY'S WARBLER					5	6			9								7			
	BLUE-GRAY GNATCATCHER					5	6			9								7			
	SCOTT'S ORIOLE					5	6			9								7			

Table 21. (continued).

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
10	TOWNSEND'S SOLITAIRE					5	6			9											10
	NORTHERN ORIOLE					5	6			9											10
	YELLOW-RUMPED WARBLER					5	6			9											10
	WARBLING VIREO					5	6			9											10
	MOUNTAIN BLUEBIRD					5	6			9											10
	RUBY-CROWNED KINGLET					5	6			9											10
	LEAST FLYCATCHER					5	6			9											10
	VIRGINIA'S WARBLER					5	6			9											10
	WIED'S CRESTED FLYCATCHER					5	6			9											10
	HAMMOND'S FLYCATCHER					5	6			9											10
	DUSKY FLYCATCHER					5	6			9											10
	HOODED ORIOLE					5	6			9											10
	BLACK-CHINNED HUMMINGBIRD					5	6			9											10
	LEWIS' WOODPECKER					5	6			9											10
	PINON JAY					5	6			9											10
	RUFOUS HUMMINGBIRD					5	6			9											10
	PAINTED REDSTART					5	6			9											10
	CALLIOPE HUMMINGBIRD					5	6			9											10
	ANNA'S HUMMINGBIRD					5	6			9											10
	SWAINSON'S THRUSH					5	6			9											10
	WESTERN BLUEBIRD					5	6			9											10
	WILLOW FLYCATCHER					5	6			9											10
	GRAY FLYCATCHER					5	6			9											10
	WESTERN FLYCATCHER					5	6			9											10
	WILSON'S WARBLER					5	6			9											10
	BROAD-TAILED HUMMINGBIRD					5	6			9											10
	ACORN WOODPECKER					5	6			9											10
11	BANDED GECKO					5	6									5	6				
	COACHWHIP					5	6									5	6				
	CANYON WREN					5	6									5	6				
	BOBCAT					5	6									5	6				
	CALIFORNIA KING SNAKE					5	6									5	6				
	ROCK WREN					5	6									5	6				
	MOUNTAIN LION					5	6									5	6				
	SONORA WHIPSNAKE					5	6									5	6				
	DESERT SPINY LIZARD					5	6									5	6				
	ROSY BOA					5	6									5	6				
12	CRISSAL THRASHER					5	6										6	7			
	MOCKINGBIRD					5	6										6	7			
	WESTERN HARVEST MOUSE					5	6										6	7			
	BROWN-HEADED COWBIRD					5	6										6	7			
	CACTUS WREN					5	6										6	7			
	CURVE-BILLED THRASHER					5	6										6	7			

Table 21. (continued).

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
13	LONG-TAIL BRUSH LIZARD					5	6										6				
	COMMON RAVEN					5	6										6				
	AMERICAN KESTREL					5	6										6				
14	SCREECH OWL					5	6											7			
	ELF OWL					5	6											7			
	BLACK-CHINNED SPARROW					5	6											7			
	LOGGERHEAD SHRIKE					5	6											7			
	COOPER'S HAWK					5	6											7			
	SCRUB JAY					5	6											7			
15	BLUE GROSBEAK					5	6														10
	GREEN-TAILED TOWHEE					5	6														10
	BLACK-THROATED GRAY WARBLER					5	6														10
	MACGILLIVRAY'S WARBLER					5	6														10
	ORANGE-CROWNED WARBLER					5	6														10
	HOUSE WREN					5	6														10
	GOSHAWK					5	6														10
	BEWICK'S WREN					5	6														10
	SHARP-SHINNED HAWK					5	6														10
	COMMON YELLOWTHROAT					5	6														10
	BLACK-HEADED GROSBEAK					5	6														10
	STELLER'S JAY					5	6														10
	COMMON CROW					5	6														10
	ZONE-TAILED HAWK					5	6														10
	SAGE THRASHER					5	6														10
	HERMIT THRUSH					5	6														10
	LAZULI BUNTING					5	6														10
16	SAY'S PHOEBE					5				9						5	6				
	SMALL-FOOTED MYOTIS					5				9						5	6				
17	LESSER NIGHTHAWK					5				9							6				
	POOR-WILL					5				9							6				
18	WESTERN KINGBIRD					5				9								7			
19	WESTERN MEADOWLARK					5				9											10
	CASSIN'S KINGBIRD					5				9											10

Table 21. (continued).

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
20	COLLARED LIZARD					5										5	6				
	WESTERN DIAMONDBACK RATTLESNAKE					5										5	6				
	BLACK-TAILED RATTLESNAKE					5										5	6				
	WESTERN SPOTTED SKUNK					5										5	6				
	GRAY FOX					5										5	6				
	CLIFF CHIPMUNK					5										5	6				
	NIGHT SNAKE					5										5	6				
	BRUSH MOUSE					5										5	6				
	CANYON MOUSE					5										5	6				
	ZEBRA-TAILED LIZARD					5										5	6				
	MOHAVE RATTLESNAKE					5										5	6				
	SPECKLED RATTLESNAKE					5										5	6				
	GREATER EARLESS LIZARD					5										5	6				
	CACTUS MOUSE					5										5	6				
	SIDE-BLOTCHED LIZARD					5										5	6				
	LYRE SNAKE					5										5	6				
21	SOUTHERN GRASSHOPPER MOUSE					5										5					
	LEOPARD LIZARD					5										5					
	ROUND-TAILED GROUND SQUIRREL					5										5					
	HARRIS' ANTELOPE SQUIRREL					5										5					
	NORTHERN GRASSHOPPER MOUSE					5										5					
	MERRIAM'S KANGAROO RAT					5										5					
22	ROADRUNNER					5											6	7			
23	SPOTTED LEAF-NOSE SNAKE					5											6				
	HOUSE MOUSE					5											6				
	PRAIRIE FALCON					5											6				
	GOLDEN EAGLE					5											6				
	PINON MOUSE					5											6				
	RED-TAILED HAWK					5											6				
	DESERT HORNED LIZARD					5											6				
	GAMBEL'S QUAIL					5											6				
	RUFOUS-SIDED TOWHEE					5											6				
	TURKEY VULTURE					5											6				
	ROCK SQUIRREL					5											6				
	CALIFORNIA WHIPTAIL					5											6				
	RUFOUS-CROWNED SPARROW					5											6				
24	BLACK-THROATED SPARROW					5												7			
	BROWN TOWHEE					5												7			

Table 21. (concluded).

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
25	CHECKERED GARTER SNAKE					5					10										
	SOUTHWEST TOAD					5					10										
	WHITE-CROWNED SPARROW					5					10										
	WATER PIPIT					5					10										
	AMERICAN ROBIN					5					10										
	FOX SPARROW					5					10										
	RED-SPOTTED TOAD					5					10										
	CHIPPING SPARROW					5					10										
	LARK SPARROW					5					10										
	LONG-EARED OWL					5					10										
	DARK-EYED JUNCO					5					10										
	BLACK-NECKED GARTER SNAKE					5					10										
	BREWER'S SPARROW					5					10										
26	HEPATIC TANAGER						6			9											10
	YELLOW-BELLIED SAPSUCKER						6			9											10
	WESTERN TANAGER						6			9											10
	SOLITARY VIREO						6			9											10
	HERMIT WARBLER						6			9											10
	CEDAR WAXWING						6			9											10
27	PHAINOPEPLA						6											7			
	PLAIN TITMOUSE						6											7			
	BUSHTIT						6											7			
	VERDIN						6											7			
28	TOWNSEND'S WARBLER						6														10
29	CAVE MYOTIS									9						5	6				
	CALIFORNIA MYOTIS									9						5	6				
	TOWNSEND'S BIG-EARED BAT									9						5	6				
	SPOTTED BAT									9						5	6				
	BRAZILIAN FREE-TAILED BAT									9						5	6				
	LONG-LEGGED MYOTIS									9						5	6				
	BIG BROWN BAT									9						5	6				
	WHITE-THROATED SWIFT									9						5	6				
	YUMA MYOTIS									9						5	6				
30	ROUGH-WINGED SWALLOW									9						5					
31	CLIFF SWALLOW									9							6				
32	BARN SWALLOW									9											10
	VAUX'S SWIFT									9											10
	VIOLET-GREEN SWALLOW									9											10
	BLACK SWIFT									9											10
	TREE SWALLOW									9											10

Table 22. Effects of habitat alterations on primary consumer and secondary consumer guilds in juniper-mixed shrub habitats (total of 52 guilds).

Impacted guilds	Impacted system or layer of habitat				
	Aquatic	Understory	Midstory	Tree bole	Overstory
Deleterious impacts					
Primary consumers[a]		9, 12-17	10, 16, 18-20		
Secondary consumers[b]		4, 13, 17, 20-25	9, 14, 18, 24, 27-28		
Totals		16 guilds (79 species)	11 guilds (29 species)		
Adverse impacts					
Primary consumers[a]		1-8, 10-11, 18	1, 4-9, 11, 14		
Secondary consumers[b]		c	1, 5-8, 10-13, 15, 22		
Totals		11+ guilds (58+ species)	20 guilds (98 species)		

[a]See Table 20 for a list of species in each identified primary consumer guild.

[b]See Table 21 for a list of species in each identified secondary consumer guild.

[c]Additional guilds of secondary consumers will be adversely affected because of changes in their food chains due to the reduced biomass of primary consumers.

Juniper-Pinyon Habitat

The juniper-pinyon type (Kuchler 1964, PNVT 23) occurs near the Hualapai mountains and in the most northeasterly portions of the study area. This habitat type comprises about 7% of the study area (U.S. Bureau of Land Management 1980). Junipers and pinyons take the form of small shrubs or medium-sized trees. They are considered a midstory growth form in which the oldest and largest specimens may provide a tree bole suitable for excavators and cavity users. Thus, this habitat type potentially provides four layers of habitat for wildlife: tree boles; a midstory canopy; an understory surface cover; and the subsurface. The density of the dominant midstory canopy of junipers and pinyons determines the density of other midstory shrub growth and of understory herbaceous vegetation. One hundred and ninety-six vertebrate species potentially utilize food sources and/or breeding substrates in juniper and pinyon habitat (Appendix II); these species are arrayed into 33 guilds of primary consumers (Table 23) and 52 guilds of secondary consumers (Table 24).

Heavy grazing of surface vegetation will deleteriously impact nine guilds of primary consumers and 12 guilds of secondary consumers (Table 25). In addition, 19 guilds of primary consumers will be adversely affected by the extensive reduction in surface vegetation. Additional guilds of secondary consumers may also be adversely affected because of food chain modifications resulting from the reduced biomass of primary consumers.

Modification of the juniper-pinyon midstory canopy by chaining, cabling, burning, bulldozing, chopping, or other mechanical means or by herbicidal application will deleteriously impact six guilds of primary consumers and eight guilds of secondary consumers. In addition, 18 guilds of primary consumers and 26 guilds of secondary consumers (Table 25) will be adversely affected by such a habitat modification.

Extensive modification of juniper-pinyon woodlands that destroys snags and tree boles large enough to be used by excavators or cavity users will impact three guilds of primary consumers and four guilds of secondary consumers. Eleven guilds of primary consumers and 20 guilds of secondary consumers (Table 25) will be adversely affected.

The impact of chaining or similar habitat modification on juniper-pinyon habitat to increase herbage production for livestock thus deleteriously or adversely affects 27 of the 33 guilds of primary consumers and 38 of the 52 guilds of secondary consumers (Table 25) in these habitats. Clearly, such management actions have a massive impact on the wildlife resources of juniper-pinyon habitats. Large-scale clearing of juniper-pinyon woodlands cannot be economically justified on the basis of watershed improvement practices (Clary 1975) and are only marginally feasible economically as a range management practice when post-treatment forage production is high (Clary et al. 1974). Neither of these economic accountings considered the additional disadvantage that this habitat modification would negatively impact over 75% of the wildlife guilds potentially using these habitats. Management of juniper-pinyon habitats

for wildlife, however, may require periodical thinning of these woodlands to encourage the production of understory and other midstory vegetation to enhance habitat quality for wildlife.

Table 23. Wildlife guilds of primary consumers in juniper-pinyon habitats in westcentral Arizona. The interpretation of the table is as in Table 5.

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
1	BLACK BEAR				4	5	6	7								5	6				
	PORCUPINE				4	5	6	7								5	6				
2	CACTUS MOUSE				4	5	6									5	6				
	DEER MOUSE				4	5	6									5	6				
	COYOTE				4	5	6									5	6				
3	STRIPED SKUNK				4	5										5	6				
	HOG-NOSED SKUNK				4	5										5	6				
4	BOTTA'S POCKET GOPHER				4	5										5					
5	COMMON FLICKER					5	6	7								5			8		
6	ANNA'S HUMMINGBIRD					5	6	7													10
	BROAD-TAILED HUMMINGBIRD					5	6	7													10
	BLACK-CHINNED HUMMINGBIRD					5	6	7													10
	ACORN WOODPECKER					5	6	7													10
	YELLOW-RUMPED WARBLER					5	6	7													10
	CALLIOPE HUMMINGBIRD					5	6	7													10
	RUFOUS HUMMINGBIRD					5	6	7													10
7	WHITE-THROATED WOODRAT					5	6									5	6	7			
8	RINGTAIL					5	6									5	6		8		
9	BRUSH MOUSE					5	6									5	6				
	STEPHENS' WOODRAT					5	6									5	6				
	GRAY FOX					5	6									5	6				
10	STARLING					5	6									5			8		
11	HARRIS' ANTELOPE SQUIRREL					5	6									5					
12	WESTERN HARVEST MOUSE					5	6										6	7	8		
	HOUSE FINCH					5	6										6	7	8		
13	MOCKINGBIRD					5	6										6	7			
	CRISSAL THRASHER					5	6										6	7			
	BROWN-HEADED COWBIRD					5	6										6	7			
14	PINON MOUSE					5	6										6		8		

Table 23. (continued).

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
15	MULE DEER					5	6										6				
	ROCK SQUIRREL					5	6										6				
	CATTLE					5	6										6				
16	CASSIN'S KINGBIRD					5	6											7	8		
17	SCRUB JAY					5	6											7			
	BUSHTIT					5	6											7			
	SCOTT'S ORIOLE					5	6											7			
	PINON JAY					5	6											7			
18	LADDER-BACKED WOODPECKER					5	6												8		
19	TOWNSEND'S SOLITAIRE					5	6														10
	MOUNTAIN BLUEBIRD					5	6														10
	SWAINSON'S THRUSH					5	6														10
	WESTERN KINGBIRD					5	6														10
	BIGHORN SHEEP					5	6														10
	ELK					5	6														10
	HERMIT THRUSH					5	6														10
	RUBY-CROWNED KINGLET					5	6														10
	AMERICAN ROBIN					5	6														10
	LESSER GOLDFINCH					5	6														10
	CLARK'S NUTCRACKER					5	6														10
	STELLER'S JAY					5	6														10
	GREEN-TAILED TOWHEE					5	6														10
	PINE SISKIN					5	6														10
	WESTERN BLUEBIRD					5	6														10
	BLACK-HEADED GROSBEAK					5	6														10
	AMERICAN GOLDFINCH					5	6														10
	LEWIS' WOODPECKER					5	6														10
	LAZULI BUNTING					5	6														10
	CACTUS WREN					5	6														10
20	CLIFF CHIPMUNK					5										5	6		8		
21	DESERT SPINY LIZARD					5										5	6				
	ARIZONA WOODRAT					5										5	6				
	WESTERN SPOTTED SKUNK					5										5	6				
	CANYON MOUSE					5										5	6				
22	SOUTHERN GRASSHOPPER MOUSE					5										5					
	NORTHERN GRASSHOPPER MOUSE					5										5					
23	MOURNING DOVE					5											6	7			

Table 23. (concluded).

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
24	COMMON RAVEN					5											6		8		
25	GAMBEL'S QUAIL					5											6				
	BLACK-TAILED JACK RABBIT					5											6				
	RUFOUS-CROWNED SPARROW					5											6				
	ROCK DOVE					5											6				
	DESERT COTTONTAIL					5											6				
	HOUSE MOUSE					5											6				
	EASTERN COTTONTAIL					5											6				
	RUFOUS-SIDED TOWHEE					5											6				
26	BLACK-CHINNED SPARROW					5												7			
	BROWN TOWHEE					5												7			
27	CASSIN'S FINCH					5															10
	PURPLE FINCH					5															10
	LARK SPARROW					5															10
	WHITE-CROWNED SPARROW					5															10
	TREE SWALLOW					5															10
	DARK-EYED JUNCO					5															10
	FOX SPARROW					5															10
	CHIPPING SPARROW					5															10
28	YELLOW-BELLIED SAPSUCKER						6	7													10
	CEDAR WAXWING						6	7													10
29	SAY'S PHOEBE						6									5	6				
30	VERDIN						6											7			
31	PLAIN TITMOUSE						6												8		
	ASH-THROATED FLYCATCHER						6												8		
32	WHITE-BREASTED NUTHATCH						6														10
	HERMIT WARBLER						6														10
	HAIRY WOODPECKER						6														10
	NORTHERN ORIOLE						6														10
	WARBLING VIREO						6														10
	RED-BREASTED NUTHATCH						6														10
	PHAINOPEPLA						6														10
	PYGMY NUTHATCH						6														10
	HOODED ORIOLE						6														10
33	WILLIAMSON'S SAPSUCKER							7													10

Table 24. Wildlife guilds of secondary consumers in juniper-pinyon habitats in westcentral Arizona. The interpretation of the table is as in Table 5.

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
1	RINGTAIL				4	5	6									5	6		8		
2	STRIPED WHIPSNAKE				4	5	6									5	6				
	BLACK BEAR				4	5	6									5	6				
	COYOTE				4	5	6									5	6				
	GOPHER SNAKE				4	5	6									5	6				
3	STRIPED SKUNK				4	5										5	6				
	LONG-NOSED SNAKE				4	5										5	6				
	HOG-NOSED SKUNK				4	5										5	6				
	GILBERT'S SKINK				4	5										5	6				
	GLOSSY SNAKE				4	5										5	6				
	WESTERN PATCH-NOSED SNAKE				4	5										5	6				
	WESTERN BLIND SNAKE				4	5										5	6				
4	RING-NECK SNAKE				4	5											6				
	ARIZONA NIGHT LIZARD				4	5											6				
5	TIGER SALAMANDER				4	5															10
6	GREAT HORNED OWL					5	6	7		9						5	6		8		
7	COMMON FLICKER					5	6	7		9						5			8		
	STARLING					5	6	7		9						5			8		
8	AMERICAN KESTREL					5	6	7		9							6		8		
9	COOPER'S HAWK					5	6	7		9								7			
	GRAY VIREO					5	6	7		9								7			
	SCOTT'S ORIOLE					5	6	7		9								7			
10	LADDER-BACKED WOODPECKER					5	6	7		9									8		

Table 24. (continued).

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
11	RUFOUS HUMMINGBIRD					5	6	7		9											10
	GOLDEN-CROWNED KINGLET					5	6	7		9											10
	CLARK'S NUTCRACKER					5	6	7		9											10
	RUBY-CROWNED KINGLET					5	6	7		9											10
	NORTHERN ORIOLE					5	6	7		9											10
	CALLIOPE HUMMINGBIRD					5	6	7		9											10
	BLACK-CHINNED HUMMINGBIRD					5	6	7		9											10
	LEWIS' WOODPECKER					5	6	7		9											10
	HOODED ORIOLE					5	6	7		9											10
	BROAD-TAILED HUMMINGBIRD					5	6	7		9											10
	ACORN WOODPECKER					5	6	7		9											10
	ANNA'S HUMMINGBIRD					5	6	7		9											10
	PYGMY NUTHATCH					5	6	7		9											10
	WARBLING VIREO					5	6	7		9											10
	WHITE-BREASTED NUTHATCH					5	6	7		9											10
	YELLOW-RUMPED WARBLER					5	6	7		9											10
12	ROCK WREN					5	6	7								5	6				
	DESERT SPINY LIZARD					5	6	7								5	6				
	CANYON WREN					5	6	7								5	6				
13	WESTERN HARVEST MOUSE					5	6	7									6	7	8		
14	COMMON RAVEN					5	6	7									6		8		
	BEWICK'S WREN					5	6	7									6		8		
15	SCRUB JAY					5	6	7										7			
16	GOSHAWK					5	6	7													10
	ZONE-TAILED HAWK					5	6	7													10
	STELLER'S JAY					5	6	7													10
	HOUSE WREN					5	6	7													10
	BLACK-THROATED GRAY WARBLER					5	6	7													10
	ORANGE-CROWNED WARBLER					5	6	7													10
	SHARP-SHINNED HAWK					5	6	7													10
17	PALLID BAT					5	6			9						5	6		8		
18	FRINGED MYOTIS					5	6			9						5	6				
19	VIRGINIA'S WARBLER					5	6			9							6				
	PAINTED REDSTART					5	6			9							6				
20	LOGGERHEAD SHRIKE					5	6			9								7			
	BLUE-GRAY GNATCATCHER					5	6			9								7			
	PINON JAY					5	6			9								7			

Table 24. (continued).

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
21	ASH-THROATED FLYCATCHER					5	6			9									8		
22	WESTERN FLYCATCHER					5	6			9											10
	WILSON'S WARBLER					5	6			9											10
	GRAY FLYCATCHER					5	6			9											10
	HAMMOND'S FLYCATCHER					5	6			9											10
	TOWNSEND'S SOLITAIRE					5	6			9											10
	LUCY'S WARBLER					5	6			9											10
	LEAST FLYCATCHER					5	6			9											10
	RED-FACED WARBLER					5	6			9											10
	WESTERN BLUEBIRD					5	6			9											10
	SWAINSON'S THRUSH					5	6			9											10
	DUSKY FLYCATCHER					5	6			9											10
	MOUNTAIN BLUEBIRD					5	6			9											10
	WILLOW FLYCATCHER					5	6			9											10
23	SONORA WHIPSNAKE					5	6									5	6				
	MOUNTAIN LION					5	6									5	6				
	COACHWHIP					5	6									5	6				
	BOBCAT					5	6									5	6				
	DEER MOUSE					5	6									5	6				
	CALIFORNIA KING SNAKE					5	6									5	6				
24	MOCKINGBIRD					5	6										6	7			
	BROWN-HEADED COWBIRD					5	6										6	7			
	CRISSAL THRASHER					5	6										6	7			
25	LONG-TAIL BRUSH LIZARD					5	6										6				
26	BLACK-CHINNED SPARROW					5	6											7			
27	SCREECH OWL					5	6												8		
28	MACGILLIVRAY'S WARBLER					5	6														10
	BLACK-HEADED GROSBEAK					5	6														10
	HERMIT THRUSH					5	6														10
	COMMON YELLOWTHROAT					5	6														10
	LAZULI BUNTING					5	6														10
	CACTUS WREN					5	6														10
	GREEN-TAILED TOWHEE					5	6														10
29	BROWN CREEPER					5		7													10

Table 24. (continued).

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
30	SMALL-FOOTED MYOTIS					5				9						5	6				
	SAY'S PHOEBE					5				9						5	6				
31	POOR-WILL					5				9							6				
32	CASSIN'S KINGBIRD					5				9								7	8		
33	WESTERN WOOD PEWEE					5				9								7			
34	WESTERN KINGBIRD					5				9											10
35	GRAY FOX					5										5	6		8		
36	SIDE-BLOTCHED LIZARD					5										5	6				
	WESTERN DIAMONDBACK RATTLESNAKE					5										5	6				
	ARIZONA BLACK RATTLESNAKE					5										5	6				
	CANYON MOUSE					5										5	6				
	COLLARED LIZARD					5										5	6				
	BRUSH MOUSE					5										5	6				
	GREATER EARLESS LIZARD					5										5	6				
	MOHAVE RATTLESNAKE					5										5	6				
	NIGHT SNAKE					5										5	6				
	CACTUS MOUSE					5										5	6				
	CLIFF CHIPMUNK					5										5	6				
	WESTERN SPOTTED SKUNK					5										5	6				
	ZEBRA-TAILED LIZARD					5										5	6				
37	SOUTHERN GRASSHOPPER MOUSE					5										5					
	NORTHERN GRASSHOPPER MOUSE					5										5					
	HARRIS' ANTELOPE SQUIRREL					5										5					
38	ROADRUNNER					5											6	7			
39	RED-TAILED HAWK					5											6		8		
	PINON MOUSE					5											6		8		
40	RUFOUS-CROWNED SPARROW					5											6				
	GAMBEL'S QUAIL					5											6				
	SHORT-HORNED LIZARD					5											6				
	ROCK SQUIRREL					5											6				
	RUFOUS-SIDED TOWHEE					5											6				
	HOUSE MOUSE					5											6				
	GOLDEN EAGLE					5											6				
	TURKEY VULTURE					5											6				
	PRAIRIE FALCON					5											6				
	CALIFORNIA WHIPTAIL					5											6				

Table 24. (continued).

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
41	BROWN TOWHEE					5												7			
42	WHITE-CROWNED SPARROW					5															10
	DARK-EYED JUNCO					5															10
	CHECKERED GARTER SNAKE					5															10
	BLACK-NECKED GARTER SNAKE					5															10
	CHIPPING SPARROW					5															10
	RED-SPOTTED TOAD					5															10
	AMERICAN ROBIN					5															10
	FOX SPARROW					5															10
	LARK SPARROW					5															10
43	HERMIT WARBLER						6	7		9											10
	WESTERN TANAGER						6	7		9											10
	SOLITARY VIREO						6	7		9											10
	HAIRY WOODPECKER						6	7		9											10
	GRACE'S WARBLER						6	7		9											10
	HEPATIC TANAGER						6	7		9											10
	YELLOW-BELLIED SAPSUCKER						6	7		9											10
	CEDAR WAXWING						6	7		9											10
44	BUSHTIT						6	7										7			
	VERDIN						6	7										7			
45	PLAIN TITMOUSE						6	7											8		
46	TOWNSEND'S WARBLER						6	7													10
	PHAINOPEPLA						6	7													10
	RED-BREASTED NUTHATCH						6	7													10
	WILLIAMSON'S SAPSUCKER						6	7													10
47	LONG-LEGGED MYOTIS									9						5	6		8		
	LITTLE BROWN MYOTIS									9						5	6		8		
	BIG BROWN BAT									9						5	6		8		
	YUMA MYOTIS									9						5	6		8		
48	WHITE-THROATED SWIFT									9						5	6				
	CAVE MYOTIS									9						5	6				
	CALIFORNIA MYOTIS									9						5	6				
	SPOTTED BAT									9						5	6				
	BRAZILIAN FREE-TAILED BAT									9						5	6				
	TOWNSEND'S BIG-EARED BAT									9						5	6				
49	ROUGH-WINGED SWALLOW									9						5					

Table 24. (concluded).

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
50	CLIFF SWALLOW									9							6				
51	VAUX'S SWIFT									9											10
	BLACK SWIFT									9											10
	TREE SWALLOW									9											10
	HOARY BAT									9											10
	VIOLET-GREEN SWALLOW									9											10
	PURPLE MARTIN									9											10
	BARN SWALLOW																				
52	LONG-EARED OWL									10							7				

Table 25. Effects of habitat alterations on primary consumer and secondary consumer guilds in juniper-pinyon habitats (total of 85 guilds).

Impacted guilds	Impacted system or layer of habitat				
	Aquatic	Understory	Midstory	Tree bole	Overstory
Deleterious impacts					
Primary consumers[a]		15, 20-27	17, 26, 29-32	18, 31, 33	
Secondary consumers[b]		4, 19, 25, 31, 35-42	9, 15, 20, 26, 33, 41, 44, 52	10, 21, 27, 45	
Totals		21 guilds (60 species)	14 guilds (25 species)	7 guilds (5 species)	
Adverse impacts					
Primary consumers[a]		1-14, 16-19, 29	1-2, 5-16, 18-19, 23, 28	1, 5, 6, 8, 10, 12, 14, 16, 20, 24, 28	
Secondary consumers[b]		c	1-2, 6-8, 10-14, 16-19, 21-25, 27-28, 32, 38, 43, 45-46	1, 6-9, 11-17, 29, 32, 35, 39, 43-44, 46-47	
Totals		19+ guilds (56+ species)	44 guilds (110 species)	31 guilds (66 species)	

[a]See Table 23 for a list of species in each identified primary consumer guild.

[b]See Table 24 for a list of species in each identified secondary consumer guild.

[c]Additional guilds of secondary consumers will be adversely affected because of changes in their food chains due to the reduced biomass of primary consumers.

Lentic Habitats

Alamo Lake, formed at the confluence of the Big Sandy and Santa Maria Rivers, is the largest lentic habitat in the planning units. Some other impoundments, like large stock tanks, may also contain similar guilds of wildlife species. Ninety-eight wildlife species potentially occur in lentic habitats in the study area (Appendix II); these species are arrayed into 10 guilds of primary consumers (Table 26) and 16 guilds of secondary consumers (Table 27). Note the guild blocks used by wildlife in this habitat type (Fig. 12).

Seven guilds of primary consumers and 11 guilds of secondary consumers will be deleteriously affected by the draining or substantial drawdown of lentic habitats (Table 28). These guilds comprise 22 species that require the lentic habitat for both feeding and breeding activities and two species of turtles that breed on the nearby terrestrial surface or in the terrestrial subsurface and require the lentic habitat for food sources.

Seven other guilds, containing 55 species, breed elsewhere, including some in nearby vegetation, and may utilize food sources in the lentic habitat sometime throughout the year. Because these species have the capability of moving long distances, they are adversely affected by the dewatering of lentic habitats because they can presumably find feeding habitat in other lentic areas.

Lentic habitats in the Sonoran Desert are artificially created habitats. Maintaining a volume of unpolluted water in these habitats is obviously advantageous to the wildlife resource.

Table 26. Wildlife guilds of primary consumers in lentic habitats in westcentral Arizona. The interpretation of the table is as in Table 5.

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
1	MOZAMBIQUE MOUTHBROODER	1	2	3									2	3	4						
2	AMERICAN COOT	1	2	3											4						
3	CANVASBACK	1	2	3																	10
	COMMON GOLDENEYE	1	2	3																	10
	REDHEAD	1	2	3																	10
	RUDDY DUCK	1	2	3																	10
	LESSER SCAUP	1	2	3																	10
	RING-NECKED DUCK	1	2	3																	10
4	CARP	1	2										2	3							
	GOLDFISH	1	2										2	3							
5	GREATER SCAUP	1	2																		10
	BUFFLEHEAD	1	2																		10
6	YELLOW BULLHEAD	1											2								
	BLACK BULLHEAD	1											2								
	CHANNEL CATFISH	1											2								
7	MOSQUITOFISH		2	3										3	4						
	GOLDEN SHINER		2	3										3	4						
	LARGEMOUTH BASS		2	3										3	4						
	THREADFIN SHAD		2	3										3	4						
8	BLUEGILL SUNFISH		2											3	4						
	GREEN SUNFISH		2											3	4						
9	SOFT-SHELLED TURTLE		2																		10

Table 26. (concluded).

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
10	COMMON SNIPE			3																	10
	BLUE-WINGED TEAL			3																	10
	GADWALL			3																	10
	LEAST SANDPIPER			3																	10
	SOLITARY SANDPIPER			3																	10
	DUNLIN			3																	10
	BONAPARTE'S GULL			3																	10
	CANADA GOOSE			3																	10
	AMERICAN AVOCET			3																	10
	BAIRD'S SANDPIPER			3																	10
	CINNAMON TEAL			3																	10
	SNOW GOOSE			3																	10
	GREEN-WINGED TEAL			3																	10
	AMERICAN WIGEON			3																	10
	MALLARD			3																	10
	PINTAIL			3																	10
	WHISTLING SWAN			3																	10
	WESTERN SANDPIPER			3																	10
	SPOTTED SANDPIPER			3																	10
	LONG-BILLED DOWITCHER			3																	10
	RING-BILLED GULL			3																	10
	NORTHERN SHOVELER			3																	10

Table 27. Wildlife guilds of secondary consumers in lentic habitats in westcentral Arizona. The interpretation of the table is as in Table 5.

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
1	MOZAMBIQUE MOUTHBROODER	1	2	3									2	3	4						
2	AMERICAN COOT	1	2	3											4						
	PIED-BILLED GREBE	1	2	3											4						
3	BUFFLEHEAD	1	2	3																	10
	RUDDY DUCK	1	2	3																	10
	CANVASBACK	1	2	3																	10
	RING-NECKED DUCK	1	2	3																	10
	COMMON GOLDENEYE	1	2	3																	10
	EARED GREBE	1	2	3																	10
	LESSER SCAUP	1	2	3																	10
	REDHEAD	1	2	3																	10
	DOUBLE-CRESTED CORMORANT	1	2	3																	10
	COMMON MERGANSER	1	2	3																	10
	COMMON LOON	1	2	3																	10
	WESTERN GREBE	1	2	3																	10
	HORNED GREBE	1	2	3																	10
4	GOLDFISH	1	2										2	3							
	CARP	1	2										2	3							
5	GREATER SCAUP	1	2																		10
6	BLACK BULLHEAD	1											2								
	CHANNEL CATFISH	1											2								
	YELLOW BULLHEAD	1											2								
7	LARGEMOUTH BASS		2	3										3	4						
	THREADFIN SHAD		2	3										3	4						
	GOLDEN SHINER		2	3										3	4						
	GREEN SUNFISH		2	3										3	4						
	BLUEGILL SUNFISH		2	3										3	4						
	MOSQUITOFISH		2	3										3	4						
8	SOFT-SHELLED TURTLE		2	3																	10
	SONORA MUD TURTLE		2	3																	10
9	TIGER SALAMANDER		2												4						

Table 27. (continued).

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
10	RED-WINGED BLACKBIRD			3						9					4						
11	BLACK TERN			3						9											10
	BREWER'S BLACKBIRD			3						9											10
	BLACK PHOEBE			3						9											10
	YELLOW-HEADED BLACKBIRD			3						9											10
12	LEOPARD FROG			3											4						
13	GREATER YELLOWLEGS			3																	10
	BLUE-WINGED TEAL			3																	10
	BALD EAGLE			3																	10
	COMMON SNIPE			3																	10
	DUNLIN			3																	10
	NORTHERN SHOVELER			3																	10
	WHITE-FACED IBIS			3																	10
	GREEN HERON			3																	10
	AMERICAN AVOCET			3																	10
	GREEN-WINGED TEAL			3																	10
	LONG-BILLED DOWITCHER			3																	10
	ROSEATE SPOONBILL			3																	10
	FORSTER'S TERN			3																	10
	BONAPARTE'S GULL			3																	10
	BELTED KINGFISHER			3																	10
	SPOTTED SANDPIPER			3																	10
	WESTERN SANDPIPER			3																	10
	BLACK-NECKED STILT			3																	10
	WHITE PELICAN			3																	10
	CINNAMON TEAL			3																	10
	NORTHERN PHALAROPE			3																	10
	RING-BILLED GULL			3																	10
	CANADA GOOSE			3																	10
	BAIRD'S SANDPIPER			3																	10
	SOLITARY SANDPIPER			3																	10
	LEAST SANDPIPER			3																	10
	MALLARD			3																	10
	WILLET			3																	10
	GREAT EGRET			3																	10
	WHISTLING SWAN			3																	10
	GREAT BLUE HERON			3																	10
	BLACK-CROWNED NIGHT HERON			3																	10
	WILSON'S PHALAROPE			3																	10
	SNOWY EGRET			3																	10

Table 27. (concluded).

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
14	CALIFORNIA LEAF-NOSED BAT									9											10
	WESTERN PIPISTRELLE									9											10
	RED BAT									9											10
	CALIFORNIA MYOTIS									9											10
	TOWNSEND'S BIG-EARED BAT									9											10
	TREE SWALLOW									9											10
	ROUGH-WINGED SWALLOW									9											10
	VIOLET-GREEN SWALLOW									9											10
	BRAZILIAN FREE-TAILED BAT									9											10
	CAVE MYOTIS									9											10
	BIG BROWN BAT									9											10
	BLACK SWIFT									9											10
	WHITE-THROATED SWIFT									9											10
	PALLID BAT									9											10
	BARN SWALLOW									9											10
	VAUX'S SWIFT									9											10
	YUMA MYOTIS									9											10
	CLIFF SWALLOW									9											10
15	SOUTHWEST TOAD										10		2								
	RED-SPOTTED TOAD										10		2								
16	WOODHOUSE'S TOAD										10				4						
	CANYON TREE FROG										10				4						
	COUCH'S SPADEFOOT TOAD										10				4						

Table 28. Effects of habitat alterations on primary consumer and secondary consumer guilds in lentic habitats (total of 26 guilds).

Impacted guilds	Impacted system or layer of habitat				
	Aquatic	Understory	Midstory	Tree bole	Overstory
Deleterious impacts					
Primary consumers[a]	1-2, 4, 6-9				
Secondary consumers[b]	1-2, 4, 6-10, 12, 15-16				
Totals	18 guilds (24 species)				
Adverse impacts					
Primary consumers[a]	3, 5, 10				
Secondary consumers[b]	3, 5, 11, 13				
Totals	7 guilds (55 species)				

[a]See Table 26 for a list of species in each identified primary consumer guild.

[b]See Table 27 for a list of species in each identified secondary consumer guild.

[c]Additional guilds of secondary consumers will be adversely affected because of changes in their food chains due to the reduced biomass of primary consumers.

Mesquite-Saltcedar Habitat

This habitat association is invading areas with a high water table in lower Sonoran Desert cover types but currently occurs in far less than 1% of the area of the planning units. Mesquite-saltcedar habitats potentially provide eight layers of habitat (bottom of water column, water column, surface of water column, terrestrial subsurface, terrestrial surface, midstory, tree bole, and tree canopy) when present in areas where water persists throughout the year. Two hundred and forty-nine vertebrate species potentially feed and/or breed in mesquite-saltcedar habitats where surface water is present (Appendix II). This fauna is arrayed into 62 guilds of primary consumers (Table 29) and 96 guilds of secondary consumers (Table 30). Mesquite-saltcedar habitats in areas with an elevated water table but no surface water lack those guilds that require free water for feeding and/or breeding substrates. Associations of mature mesquite (Prosopis spp.) and saltcedars (Tamarix chinensis) may become so dense that understory forage production is very low, restricting those guilds that require surface cover as feeding and/or breeding substrates. The following discussion pertains to an open stand of mesquite-saltcedar trees that are of sufficient size and maturity to provide both a tree overstory canopy and a tree bole for excavators and cavity users. Abundant surface vegetation and surface water are presumed present. The maintenance of mesquite-saltcedar habitats as open stands or their conversion to cottonwood-willow riparian habitats are very favorable habitat management practices for wildlife in the lower Sonoran Desert.

Dewatering desert streams so that flows become intermittent will deleteriously impact 11 guilds of primary consumers and 13 guilds of secondary consumers (Table 31) in mesquite-saltcedar habitats. In addition, eight guilds of primary consumers and 23 guilds of secondary consumers will be adversely impacted.

Heavy grazing of surface vegetation in open mesquite-saltcedar habitats will deleteriously impact 14 guilds of primary consumers and 16 guilds of secondary consumers. In addition, 39 guilds of primary consumers will be adversely impacted. Several guilds of secondary consumers will also be adversely impacted because of changes in their food chains due to a reduction in the biomass of primary consumers.

Elimination of midstory mesquite and saltcedar will deleteriously impact five guilds of primary consumers and five guilds of secondary consumers (Table 31). Thirty-four guilds of primary consumers and 48 guilds of secondary consumers will be adversely affected.

The bole of the largest saltcedars and some mesquite trees may be suitable habitat for excavators and cavity users. Removal of snags or large tree boles will have a deleterious impact on two guilds of primary consumers and four guilds of secondary consumers. In addition, 13 guilds of primary consumers and 27 guilds of secondary consumers (Table 31) will be adversely affected.

Elimination of the crowns of the tallest trees will deleteriously impact one primary consumer guild and one secondary consumer guild. In addition, 26 guilds of primary consumers and 36 guilds of secondary consumers will be adversely affected.

Table 29. Wildlife guilds of primary consumers in mesquite-saltcedar riparian habitats in westcentral Arizona. The interpretation of the table is as in Table 5.

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
1	AMERICAN COOT	1	2	3		5									4						
2	MALLARD	1	2	3		5											6				
3	AMERICAN WIGEON	1	2	3		5															10
	CANADA GOOSE	1	2	3		5															10
	PINTAIL	1	2	3		5															10
	GADWALL	1	2	3		5															10
4	RED SHINER	1	2	3									2	3	4						
	LONGFIN DACE	1	2	3									2	3	4						
5	GILA SUCKER	1	2	3									2		4						
6	REDHEAD	1	2	3													6				
7	CANVASBACK	1	2	3																	10
	RUDDY DUCK	1	2	3																	10
	RING-NECKED DUCK	1	2	3																	10
8	CARP	1	2										2	3							
9	BLACK BULLHEAD	1											2								
	YELLOW BULLHEAD	1											2								
	GILA MOUNTAIN-SUCKER	1											2								
10	ROUNDTAIL CHUB		2	3										3	4						
11	GREEN SUNFISH		2											3	4						
12	PORCUPINE			3	4	5	6	7	8							5	6				
13	BEAVER			3	4	5	6								4	5					
14	MUSKRAT			3		5									4	5					
15	CINNAMON TEAL			3		5											6				
16	COMMON GALLINULE			3		5												7			

Table 29. (continued).

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
17	BAIRD'S SANDPIPER			3		5															10
	GREEN-WINGED TEAL			3		5															10
	SOLITARY SANDPIPER			3		5															10
	SPOTTED SANDPIPER			3		5															10
	LEAST SANDPIPER			3		5															10
	DUNLIN			3		5															10
	BLUE-WINGED TEAL			3		5															10
	COMMON SNIPE			3		5															10
18	SORA			3													6				
19	AMERICAN AVOCET			3																	10
	NORTHERN SHOVELER			3																	10
	LONG-BILLED DOWITCHER			3																	10
20	CACTUS MOUSE				4	5	6		8							5	6				
21	COLLARED PECCARY				4	5	6									5	6				
	COYOTE				4	5	6									5	6				
22	STRIPED SKUNK				4	5										5	6				
23	BOTTA'S POCKET GOPHER				4	5										5					
24	COMMON FLICKER					5	6	7	8							5			8		
25	BLACK-CHINNED HUMMINGBIRD					5	6	7	8								6	7		9	
	COSTA'S HUMMINGBIRD					5	6	7	8								6	7		9	
26	ANNA'S HUMMINGBIRD					5	6	7	8												10
	SCOTT'S ORIOLE					5	6	7	8												10
	YELLOW-RUMPED WARBLER					5	6	7	8												10
27	RACCOON					5	6		8							5	6	7	8		
28	RINGTAIL					5	6		8							5	6		8		
29	GRAY FOX					5	6		8							5	6				
30	STARLING					5	6		8							5			8		
31	WESTERN HARVEST MOUSE					5	6		8								6	7	8		
32	GREAT-TAILED GRACKLE					5	6		8								6	7		9	
	LESSER GOLDFINCH					5	6		8								6	7		9	
	MOCKINGBIRD					5	6		8								6	7		9	

Table 29. (continued).

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
33	ROCK SQUIRREL					5	6		8								6				
34	WESTERN KINGBIRD					5	6		8									7	8		
	CASSIN'S KINGBIRD					5	6		8									7	8		
35	GILA WOODPECKER					5	6		8										8		
	LADDER-BACKED WOODPECKER					5	6		8										8		
36	WHITE-WINGED DOVE					5	6		8											9	
37	MOUNTAIN BLUEBIRD					5	6		8												10
	WESTERN BLUEBIRD					5	6		8												10
	RUBY-CROWNED KINGLET					5	6		8												10
	AMERICAN GOLDFINCH					5	6		8												10
	AMERICAN ROBIN					5	6		8												10
	LAWRENCE'S GOLDFINCH					5	6		8												10
	BLACK-HEADED GROSBEAK					5	6		8												10
	COMMON CROW					5	6		8												10
	BUSHTIT					5	6		8												10
	LEWIS' WOODPECKER					5	6		8												10
38	WHITE-THROATED WOODRAT					5	6									5	6	7			
39	ROUND-TAILED GROUND SQUIRREL					5	6									5					
	HARRIS' ANTELOPE SQUIRREL					5	6									5					
40	HOUSE FINCH					5	6										6	7	8	9	
	CACTUS WREN					5	6										6	7	8	9	
41	BROWN-HEADED COWBIRD					5	6										6	7		9	
42	CURVE-BILLED THRASHER					5	6										6	7			
	RED-WINGED BLACKBIRD					5	6										6	7			
	CRISSAL THRASHER					5	6										6	7			
	YELLOW-BREASTED CHAT					5	6										6	7			
43	BURRO					5	6										6				
	MULE DEER					5	6										6				
	CATTLE					5	6										6				
44	HOUSE SPARROW					5	6											7	8	9	
45	CARDINAL					5	6											7			

Table 29. (continued).

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
46	GREEN-TAILED TOWHEE					5	6														10
	HERMIT THRUSH					5	6														10
	BREWER'S BLACKBIRD					5	6														10
	SWAINSON'S THRUSH					5	6														10
	LAZULI BUNTING					5	6														10
	SAGE THRASHER					5	6														10
	YELLOW-HEADED BLACKBIRD					5	6														10
47	PURPLE FINCH					5			8												10
48	WESTERN SPOTTED SKUNK					5										5	6				
	DESERT SPINY LIZARD					5										5	6				
	ARIZONA WOODRAT					5										5	6				
49	ARIZONA POCKET MOUSE					5										5					
	DESERT TORTOISE					5										5					
	ROCK POCKET MOUSE					5										5					
	DESERT POCKET MOUSE					5										5					
	SOUTHERN GRASSHOPPER MOUSE					5										5					
	MERRIAM'S KANGAROO RAT					5										5					
	BAILEY'S POCKET MOUSE					5										5					
50	MOURNING DOVE					5											6	7		9	
51	SONG SPARROW					5											6	7			
	ABERT'S TOWHEE					5											6	7			
52	COMMON RAVEN					5											6		8	9	
53	DESERT COTTONTAIL					5											6				
	ROCK DOVE					5											6				
	HOUSE MOUSE					5											6				
	BLACK-TAILED JACK RABBIT					5											6				
	GAMBEL'S QUAIL					5											6				
54	BLACK-THROATED SPARROW					5												7			
	BROWN TOWHEE					5												7			

Table 29. (concluded).

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
55	SAVANNAH SPARROW					5															10
	TREE SWALLOW					5															10
	CHIPPING SPARROW					5															10
	SAGE SPARROW					5															10
	BREWER'S SPARROW					5															10
	LARK SPARROW					5															10
	LINCOLN'S SPARROW					5															10
	WATER PIPIT					5															10
	DARK-EYED JUNCO					5															10
	WHITE-CROWNED SPARROW					5															10
56	YELLOW-BELLIED SAPSUCKER						6	7	8												10
57	SAY'S PHOEBE						6		8								5	6			
58	PHAINOPEPLA						6		8										7		9
	NORTHERN ORIOLE						6		8										7		9
	HOODED ORIOLE						6		8										7		9
59	VERDIN						6		8										7		
60	ASH-THROATED FLYCATCHER						6		8											8	
	WIED'S CRESTED FLYCATCHER						6		8											8	
61	BRIDLED TITMOUSE						6		8												10
	WESTERN TANAGER						6		8												10
	WARBLING VIREO						6		8												10
	SUMMER TANAGER						6		8												10
62	HERMIT WARBLER						6														10

Table 30. Wildlife guilds of secondary consumers in mesquite-saltcedar riparian habitats in westcentral Arizona. The interpretation of the table is as in Table 5.

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
1	MUSKRAT	1	2	3		5									4	5					
2	AMERICAN COOT	1	2	3		5									4						
3	GREAT BLUE HERON	1	2	3		5											6			9	
4	MALLARD	1	2	3		5											6				
5	GREEN HERON	1	2	3		5												7		9	
	GREAT EGRET	1	2	3		5												7		9	
	BLACK-CROWNED NIGHT HERON	1	2	3		5												7		9	
6	AMERICAN BITTERN	1	2	3		5															10
	SNOWY EGRET	1	2	3		5															10
	CANADA GOOSE	1	2	3		5															10
7	RED SHINER	1	2	3									2	3	4						
	LONGFIN DACE	1	2	3									2	3	4						
8	GILA SUCKER	1	2	3									2		4						
9	PIED-BILLED GREBE	1	2	3											4						
10	REDHEAD	1	2	3													6				
11	RING-NECKED DUCK	1	2	3																	10
	EARED GREBE	1	2	3																	10
	RUDDY DUCK	1	2	3																	10
	CANVASBACK	1	2	3																	10
12	CARP	1	2										2	3							
13	RACCOON	1		3		5	6		8							5	6	7	8		
14	WHITE-FACED IBIS	1		3		5															10
15	GILA MOUNTAIN-SUCKER	1											2								
	YELLOW BULLHEAD	1											2								
	BLACK BULLHEAD	1											2								

Table 30. (continued).

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
16	BLACK-NECKED GARTER SNAKE		2	3		5											6				
17	GREEN SUNFISH		2	3											3	4					
	ROUNDTAIL CHUB		2	3											3	4					
18	CHECKERED GARTER SNAKE		2			5											6				
19	COYOTE			3	4	5	6									5	6				
20	STRIPED SKUNK			3	4	5										5	6				
21	GREEN-WINGED TEAL			3	4																10
22	COOPER'S HAWK			3		5	6	7	8	9											10
23	COMMON RAVEN			3		5	6	7	8								6		8	9	
24	RED-WINGED BLACKBIRD			3		5	6			9							6	7			
25	LONG-BILLED MARSH WREN			3		5	6			9											10
	YELLOW-HEADED BLACKBIRD			3		5	6			9											10
	BREWER'S BLACKBIRD			3		5	6			9											10
26	GREAT-TAILED GRACKLE			3		5	6										6	7		9	
27	BOBCAT			3		5	6														10
	LEAST BITTERN			3		5	6														10
28	BLACK PHOEBE			3		5				9							6				
29	LEOPARD FROG			3		5									4						
30	WESTERN SPOTTED SKUNK			3		5										5	6				
31	CINNAMON TEAL			3		5											6				
	SORA			3		5											6				
32	COMMON GALLINULE			3		5												7			

Table 30. (continued).

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
33	DUNLIN			3		5					10										10
	BAIRD'S SANDPIPER			3		5					10										10
	AMERICAN AVOCET			3		5					10										10
	LONG-BILLED DOWITCHER			3		5					10										10
	COMMON SNIPE			3		5					10										10
	LEAST SANDPIPER			3		5					10										10
	NORTHERN WATERTHRUSH			3		5					10										10
	LONG-BILLED CURLEW			3		5					10										10
	WILLET			3		5					10										10
	BLUE-WINGED TEAL			3		5					10										10
	BLACK-NECKED STILT			3		5					10										10
	GREATER YELLOWLEGS			3		5					10										10
34	SPOTTED SANDPIPER			3							10										10
	BELTED KINGFISHER			3							10										10
	SOLITARY SANDPIPER			3							10										10
	NORTHERN SHOVELER			3							10										10
35	RINGTAIL				4	5	6		8							5	6		8		
36	GOPHER SNAKE				4	5	6									5	6				
37	COLLARED PECCARY				4	5										5	6				
	LONG-NOSED SNAKE				4	5										5	6				
	GLOSSY SNAKE				4	5										5	6				
	MEXICAN BLACK-HEADED SNAKE				4	5										5	6				
	WESTERN BLIND SNAKE				4	5										5	6				
	GILBERT'S SKINK				4	5										5	6				
	WESTERN PATCH-NOSED SNAKE				4	5										5	6				
38	CORAL SNAKE				4	5										5					
39	BADGER				4	5															10
40	GREAT HORNED OWL					5	6	7	8	9						5	6		8	9		
41	COMMON FLICKER					5	6	7	8	9						5			8		
	STARLING					5	6	7	8	9						5			8		
42	COSTA'S HUMMINGBIRD					5	6	7	8	9							6	7		9	
	BLACK-CHINNED HUMMINGBIRD					5	6	7	8	9							6	7		9	
43	AMERICAN KESTREL					5	6	7	8	9							6		8		

Table 30. (continued).

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
44	HOODED ORIOLE					5	6	7	8	9								7		9	
	YELLOW WARBLER					5	6	7	8	9								7		9	
	NORTHERN ORIOLE					5	6	7	8	9								7		9	
45	BELL'S VIREO					5	6	7	8	9								7			
46	GILA WOODPECKER					5	6	7	8	9									8		
	ELF OWL					5	6	7	8	9									8		
	LADDER-BACKED WOODPECKER					5	6	7	8	9									8		
47	YELLOW-RUMPED WARBLER					5	6	7	8	9											10
	LEWIS' WOODPECKER					5	6	7	8	9											10
	RUBY-CROWNED KINGLET					5	6	7	8	9											10
	WARBLING VIREO					5	6	7	8	9											10
	SCOTT'S ORIOLE					5	6	7	8	9											10
	FLAMMULATED OWL					5	6	7	8	9											10
	ANNA'S HUMMINGBIRD					5	6	7	8	9											10
48	WESTERN HARVEST MOUSE					5	6	7	8								6	7	8		
49	BEWICK'S WREN					5	6	7	8								6		8		
50	HOUSE WREN					5	6	7	8												10
	SAW-WHET OWL					5	6	7	8												10
	SHARP-SHINNED HAWK					5	6	7	8												10
	BLACK-THROATED GRAY WARBLER					5	6	7	8												10
	ORANGE-CROWNED WARBLER					5	6	7	8												10
51	ROCK WREN					5	6	7								5	6				
	DESERT SPINY LIZARD					5	6	7								5	6				
	CANYON WREN					5	6	7								5	6				
52	GOSHAWK					5	6	7													10
53	PALLID BAT					5	6		8	9						5	6		8		
54	CALIFORNIA LEAF-NOSED BAT					5	6		8	9						5	6				
55	WILLOW FLYCATCHER					5	6		8	9							6	7			
56	RED BAT					5	6		8	9									8		
	WIED'S CRESTED FLYCATCHER					5	6		8	9									8		
	ASH-THROATED FLYCATCHER					5	6		8	9									8		

Table 30. (continued).

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
57	BLUE-GRAY GNATCATCHER					5	6		8	9											10
	HAMMOND'S FLYCATCHER					5	6		8	9											10
	WESTERN FLYCATCHER					5	6		8	9											10
	LEAST FLYCATCHER					5	6		8	9											10
	GRAY FLYCATCHER					5	6		8	9											10
	DUSKY FLYCATCHER					5	6		8	9											10
58	CACTUS WREN					5	6		8								6	7	8	9	
59	SCREECH OWL					5	6		8										8		
60	LAZULI BUNTING					5	6		8												10
	BLACK-HEADED GROSBEAK					5	6		8												10
	COMMON CROW					5	6		8												10
61	BLACK-TAILED GNATCATCHER					5	6			9							6	7			
62	HOUSE SPARROW					5	6			9								7	8	9	
63	LOGGERHEAD SHRIKE					5	6			9								7		9	
64	LUCY'S WARBLER					5	6			9									8		
65	MOUNTAIN BLUEBIRD					5	6			9											10
	VIRGINIA'S WARBLER					5	6			9											10
	WESTERN BLUEBIRD					5	6			9											10
	SWAINSON'S THRUSH					5	6			9											10
	WILSON'S WARBLER					5	6			9											10
66	COACHWHIP					5	6									5	6				
	CALIFORNIA KING SNAKE					5	6									5	6				
67	MOCKINGBIRD					5	6										6	7		9	
	BROWN-HEADED COWBIRD					5	6										6	7		9	
68	ABERT'S TOWHEE					5	6										6	7			
	SONG SPARROW					5	6										6	7			
	CURVE-BILLED THRASHER					5	6										6	7			
	COMMON YELLOWTHROAT					5	6										6	7			
	YELLOW-BREASTED CHAT					5	6										6	7			
	CRISSAL THRASHER					5	6										6	7			
69	CARDINAL					5	6											7			

Table 30. (continued).

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
70	SAGE THRASHER					5	6														10
	GREEN-TAILED TOWHEE					5	6														10
	HERMIT THRUSH					5	6														10
	MACGILLIVRAY'S WARBLER					5	6														10
71	SAY'S PHOEBE					5				9						5	6				
72	CASSIN'S KINGBIRD					5				9								7	8		
	WESTERN KINGBIRD					5				9								7	8		
73	VERMILION FLYCATCHER					5				9								7		9	
74	WESTERN WOOD PEWEE					5				9											10
	LESSER NIGHTHAWK					5				9											10
75	COLORADO RIVER TOAD					5								3							
76	RED-SPOTTED TOAD					5									4						
	COUCH'S SPADEFOOT TOAD					5									4						
	SOUTHWEST TOAD					5									4						
	WOODHOUSE'S TOAD					5									4						
77	CACTUS MOUSE					5										5	6				
	GREATER EARLESS LIZARD					5										5	6				
	WESTERN DIAMONDBACK RATTLESNAKE					5										5	6				
	MOHAVE RATTLESNAKE					5										5	6				
	ZEBRA-TAILED LIZARD					5										5	6				
	GRAY FOX					5										5	6				
	SIDE-BLOTCHED LIZARD					5										5	6				
78	SOUTHERN GRASSHOPPER MOUSE					5										5					
	ROUND-TAILED GROUND SQUIRREL					5										5					
	HARRIS' ANTELOPE SQUIRREL					5										5					
	MERRIAM'S KANGAROO RAT					5										5					
79	ROADRUNNER					5											6	7			
80	RED-TAILED HAWK					5											6		8	9	
81	HOUSE MOUSE					5											6				
	CALIFORNIA WHIPTAIL					5											6				
	KILLDEER					5											6				
	ROCK SQUIRREL					5											6				
	SPOTTED LEAF-NOSE SNAKE					5											6				
	DESERT SHREW					5											6				
	GAMBEL'S QUAIL					5											6				
	TURKEY VULTURE					5											6				

Table 30. (continued).

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
82	BLACK-THROATED SPARROW					5												7			
	BROWN TOWHEE					5												7			
83	WATER PIPIT					5															10
	CHIPPING SPARROW					5															10
	AMERICAN ROBIN					5															10
	LARK SPARROW					5															10
	DARK-EYED JUNCO					5															10
	LINCOLN'S SPARROW					5															10
	BREWER'S SPARROW					5															10
	SAGE SPARROW					5															10
	SAVANNAH SPARROW					5															10
	WHITE-CROWNED SPARROW					5															10
84	HERMIT WARBLER						6	7	8	9											10
	YELLOW-BELLIED SAPSUCKER						6	7	8	9											10
	SUMMER TANAGER						6	7	8	9											10
	AMERICAN REDSTART						6	7	8	9											10
	SOLITARY VIREO						6	7	8	9											10
	WESTERN TANAGER						6	7	8	9											10
85	PHAINOPEPLA						6	7	8									7		9	
86	VERDIN						6	7	8									7			
87	BUSHTIT						6	7	8												10
	TOWNSEND'S WARBLER						6	7	8												10
	BRIDLED TITMOUSE						6	7	8												10
88	LONG-TAIL BRUSH LIZARD						6	7									6				
	TREE LIZARD						6	7									6				
89	YELLOW-BILLED CUCKOO						6		8									7		9	
90	BIG BROWN BAT									9						5	6		8		
	YUMA MYOTIS									9						5	6		8		
91	BRAZILIAN FREE-TAILED BAT									9						5	6				
	WHITE-THROATED SWIFT									9						5	6				
	SPOTTED BAT									9						5	6				
	CALIFORNIA MYOTIS									9						5	6				
	CAVE MYOTIS									9						5	6				
	WESTERN PIPISTRELLE									9						5	6				
	TOWNSEND'S BIG-EARED BAT									9						5	6				

Table 30. (concluded).

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
92	ROUGH-WINGED SWALLOW									9						5					
93	CLIFF SWALLOW									9							6				
94	BARN SWALLOW									9											10
	VAUX'S SWIFT									9											10
	VIOLET-GREEN SWALLOW									9											10
	TREE SWALLOW									9											10
	BLACK SWIFT									9											10
95	BARN OWL										10					5	6				
96	LONG-EARED OWL										10									9	
	DOUBLE-CRESTED CORMORANT										10									9	

Table 31. Effects of habitat alterations on primary consumer and secondary consumer guilds in mesquite-saltcedar habitats (total of 158 guilds).

Impacted guilds	Impacted system or layer of habitat				
	Aquatic	Understory	Midstory	Tree bole	Overstory
Deleterious impacts					
Primary consumers[a]	1, 4-11, 18-19	2, 6, 15, 18, 33, 43, 48-55	16, 45, 54, 59, 62	35, 60	36
Secondary consumers[b]	2, 7-12, 15, 17, 29, 34, 75-76	4, 10, 16, 18, 28, 31, 75-83, 88	32, 45, 69, 82, 86	46, 56, 59, 64	96
Totals	24 guilds (29 species)	30 guilds (66 species)	10 guilds (7 species)	6 guilds (8 species)	2 guilds (3 species)
Adverse impacts					
Primary consumers[a]	2-3, 12-17	1, 3, 12-17, 20-46, 48, 50-52	12-13, 20-21, 24-46, 50-51, 56-61	12, 24-28, 30-31, 34, 40, 44, 52, 56	12, 20, 24-37, 40-41, 44, 47, 50, 52, 56-61
Secondary consumers[b]	1, 3-6, 13-14, 16, 18-28, 30-33	c	5, 13, 19, 22-27, 35-36, 40-44, 46-68, 70, 84-85, 87-89	13, 22-23, 35, 40-45, 47-53, 58, 62, 72, 80, 84-88, 90	3, 5, 13, 22-23, 26, 35, 40-50, 53-60, 62-63, 67, 73, 80, 84-87, 89
Totals	31 guilds (49 species)	39+ guilds (82+ species)	82 guilds (123 species)	40 guilds (56 species)	62 guilds (87 species)

[a]See Table 29 for a list of species in each identified primary consumer guild.

[b]See Table 30 for a list of species in each identified secondary consumer guild.

[c]Additional guilds of secondary consumers will be adversely affected because of changes in their food chains due to the reduced biomass of primary consumers.

Mixed Broad Leaf Riparian Habitat

This habitat type containing mixtures of Gambel's oak (Quercus gambelii), walnut (Juglans major), alder (Alnus oblongifolia), ash (Fraxinus pennsylvanicus), and sycamore (Platanus wrightii) (Millsap 1981), occurs as a narrow strip along streams at higher elevations than the cottonwood-willow riparian vegetation type. Both types potentially provide eight layers of habitat to the wildlife community (bottom of the water column, water column, surface of the water column, terrestrial subsurface, terrestrial surface, midstory, tree bole, and tree canopy). Note the guild blocks used by wildlife in this habitat type (Fig. 16). Mixed broad leaf riparian habitat occurs on less than 0.1% of the planning units (Millsap 1981) and is potentially used by 238 species (Appendix II), a species richness only slightly less than that of cottonwood-willow and mesquite-tamarisk riparian areas. The rich vertebrate fauna is arrayed into 56 guilds of primary consumers (Table 32) and 103 guilds of secondary consumers (Table 33). This habitat type, like the cottonwood-willow areas, should be managed as rare and endangered habitat of great importance to the wildlife community of the Sonoran Desert.

Dewatering of streams so that instream flows become intermittent and of limited volume will deleteriously impact seven guilds of primary consumers and 13 guilds of secondary consumers (Table 34). In addition, six guilds of primary consumers and 21 guilds of secondary consumers will be adversely affected.

Heavy grazing of surface vegetation will deleteriously impact the breeding and feeding substrate of 11 guilds of primary consumers and 21 guilds of secondary consumers (Table 34). In addition, 32 guilds of primary consumers will be adversely affected. Some secondary consumers will also be adversely affected because their food chains will be modified due to the reduced biomass of many primary consumers.

Removal of midstory vegetation will deleteriously impact three guilds of primary consumers and four guilds of secondary consumers (Table 34). Thirty-three guilds of primary consumers and 57 guilds of secondary consumers will be adversely affected.

The removal of snags or tree boles with a large enough diameter to be used by excavators and cavity users will deleteriously impact four guilds of primary consumers and seven guilds of secondary consumers (Table 34). In addition, 13 guilds of primary consumers and 36 guilds of secondary consumers will be adversely affected.

The removal of the tree canopy will deleteriously impact one guild of primary consumers and four guilds of secondary consumers. In addition, 28 guilds of primary consumers and 43 guilds of secondary consumers will be adversely affected.

Table 32. Wildlife guilds of primary consumers in mixed broad leaf riparian habitats in westcentral Arizona. The interpretation of the table is as in Table 5.

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
1	MALLARD	1	2	3		5											6				
2	GADWALL	1	2	3		5															10
	CANADA GOOSE	1	2	3		5															10
3	LONGFIN DACE	1	2	3									2	3	4						
4	GILA SUCKER	1	2	3									2		4						
5	SPECKLED DACE	1	2										2	3							
6	GILA MOUNTAIN-SUCKER	1											2								
7	ROUNDTAIL CHUB		2	3										3	4						
8	SOFT-SHELLED TURTLE		2														6				
9	PORCUPINE			3	4	5	6	7	8							5	6				
10	BEAVER			3	4	5	6								4	5					
11	CINNAMON TEAL			3		5											6				
12	SPOTTED SANDPIPER			3		5															10
13	NORTHERN SHOVELER			3																	10
14	BLACK BEAR				4	5	6	7	8							5	6				
15	CACTUS MOUSE				4	5	6		8							5	6				
16	DEER MOUSE				4	5	6									5	6				
	COYOTE				4	5	6									5	6				
	COLLARED PECCARY				4	5	6									5	6				
17	STRIPED SKUNK				4	5										5	6				
	HOG-NOSED SKUNK				4	5										5	6				
18	BOTTA'S POCKET GOPHER				4	5										5					
19	COMMON FLICKER					5	6	7	8							5			8		
20	BROAD-TAILED HUMMINGBIRD					5	6	7	8								6	7		9	
	BLACK-CHINNED HUMMINGBIRD					5	6	7	8								6	7		9	
	COSTA'S HUMMINGBIRD					5	6	7	8								6	7		9	

Table 32. (continued).

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
21	ACORN WOODPECKER					5	6	7	8										8		
22	ANNA'S HUMMINGBIRD					5	6	7	8												10
	YELLOW-RUMPED WARBLER					5	6	7	8												10
	RUFOUS HUMMINGBIRD					5	6	7	8												10
	CALLIOPE HUMMINGBIRD					5	6	7	8												10
23	RACCOON					5	6		8							5	6	7	8		
24	GRAY FOX					5	6		8							5	6		8		
	RINGTAIL					5	6		8							5	6		8		
25	WESTERN HARVEST MOUSE					5	6		8								6	7	8		
26	AMERICAN ROBIN					5	6		8								6	7		9	
	LESSER GOLDFINCH					5	6		8								6	7		9	
27	ROCK SQUIRREL					5	6		8								6				
28	WESTERN KINGBIRD					5	6		8									7	8	9	
	CASSIN'S KINGBIRD					5	6		8									7	8	9	
29	BUSHTIT					5	6		8									7		9	
	STELLER'S JAY					5	6		8									7		9	
	SCRUB JAY					5	6		8									7		9	
30	BLACK-HEADED GROSBEAK					5	6		8									7			
31	LADDER-BACKED WOODPECKER					5	6		8										8		
	WESTERN BLUEBIRD					5	6		8										8		
	GILA WOODPECKER					5	6		8										8		
32	WHITE-WINGED DOVE					5	6		8											9	
33	TOWNSEND'S SOLITAIRE					5	6		8												10
	CLARK'S NUTCRACKER					5	6		8												10
	PINE SISKIN					5	6		8												10
	MOUNTAIN BLUEBIRD					5	6		8												10
	PINON JAY					5	6		8												10
	RUBY-CROWNED KINGLET					5	6		8												10
	AMERICAN GOLDFINCH					5	6		8												10
	LEWIS' WOODPECKER					5	6		8												10
34	WHITE-THROATED WOODRAT					5	6									5	6	7			

Table 32. (continued).

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
35	BRUSH MOUSE					5	6									5	6				
	STEPHENS' WOODRAT					5	6									5	6				
36	HARRIS' ANTELOPE SQUIRREL					5	6									5					
37	HOUSE FINCH					5	6										6	7	8	9	
	CACTUS WREN					5	6										6	7	8	9	
38	BROWN-HEADED COWBIRD					5	6										6	7		9	
39	CRISSAL THRASHER					5	6										6	7			
	YELLOW-BREASTED CHAT					5	6										6	7			
	LAZULI BUNTING					5	6										6	7			
40	CATTLE					5	6										6				
	MULE DEER					5	6										6				
41	CARDINAL					5	6											7			
	HERMIT THRUSH					5	6											7			
	BLUE GROSBEAK					5	6											7			
42	SWAINSON'S THRUSH					5	6														10
	GREEN-TAILED TOWHEE					5	6														10
43	CASSIN'S FINCH					5			8												10
	PURPLE FINCH					5			8												10
44	CLIFF CHIPMUNK					5										5	6		8		
45	DESERT SPINY LIZARD					5										5	6				
	WESTERN SPOTTED SKUNK					5										5	6				
	ARIZONA WOODRAT					5										5	6				
46	MOURNING DOVE					5											6	7		9	
47	COMMON RAVEN					5											6		8	9	
48	ROCK DOVE					5											6				
	DESERT COTTONTAIL					5											6				
	BLACK-TAILED JACK RABBIT					5											6				
	GAMBEL'S QUAIL					5											6				
	HOUSE MOUSE					5											6				
	RUFOUS-SIDED TOWHEE					5											6				
	EASTERN COTTONTAIL					5											6				

Table 32. (concluded).

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
49	LINCOLN'S SPARROW					5															10
	CHIPPING SPARROW					5															10
	TREE SWALLOW					5															10
	WATER PIPIT					5															10
	FOX SPARROW					5															10
	WHITE-CROWNED SPARROW					5															10
	DARK-EYED JUNCO					5															10
50	CEDAR WAXWING						6	7	8												10
	YELLOW-BELLIED SAPSUCKER						6	7	8												10
51	SAY'S PHOEBE						6		8								5	6			
52	SUMMER TANAGER						6		8										7		9
	HOODED ORIOLE						6		8										7		9
	WARBLING VIREO						6		8										7		9
	NORTHERN ORIOLE						6		8										7		9
53	VERDIN						6		8										7		
54	PLAIN TITMOUSE						6		8											8	
	ASH-THROATED FLYCATCHER						6		8											8	
	BRIDLED TITMOUSE						6		8											8	
	WIED'S CRESTED FLYCATCHER						6		8											8	
	WHITE-BREASTED NUTHATCH						6		8											8	
55	HAIRY WOODPECKER						6		8												10
	RED-BREASTED NUTHATCH						6		8												10
	HERMIT WARBLER						6		8												10
	WESTERN TANAGER						6		8												10
	PHAINOPEPLA						6		8												10
	PYGMY NUTHATCH						6		8												10
	DOWNY WOODPECKER						6		8												10
56	WILLIAMSON'S SAPSUCKER							7													10

Table 33. Wildlife guilds of secondary consumers in mixed broad leaf riparian habitats in westcentral Arizona. The interpretation of the table is as in Table 5.

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
1	GREAT BLUE HERON	1	2	3		5											6			9	
2	MALLARD	1	2	3		5											6				
3	GREEN HERON	1	2	3		5												7		9	
	BLACK-CROWNED NIGHT HERON	1	2	3		5												7		9	
4	GREAT EGRET	1	2	3		5															10
	SNOWY EGRET	1	2	3		5															10
	AMERICAN BITTERN	1	2	3		5															10
	CANADA GOOSE	1	2	3		5															10
5	LONGFIN DACE	1	2	3									2	3	4						
6	GILA SUCKER	1	2	3									2		4						
7	PIED-BILLED GREBE	1	2	3											4						
8	COMMON MERGANSER	1	2	3												5	6	7	8		
9	EARED GREBE	1	2	3																	10
10	SPECKLED DACE	1	2										2	3							
11	RACCOON	1		3		5	6		8							5	6	7	8		
12	WHITE-FACED IBIS	1		3		5															10
13	GILA MOUNTAIN-SUCKER	1											2								
14	BLACK-NECKED GARTER SNAKE		2	3		5											6				
15	ROUNDTAIL CHUB		2	3										3	4						
16	YELLOW MUD TURTLE		2	3													6				
	SONORA MUD TURTLE		2	3													6				
	SOFT-SHELLED TURTLE		2	3													6				
17	CHECKERED GARTER SNAKE		2			5											6				

Table 33. (continued).

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
18	COYOTE			3	4	5	6									5	6				
19	HOG-NOSED SKUNK			3	4	5										5	6				
	STRIPED SKUNK			3	4	5										5	6				
20	COOPER'S HAWK			3		5	6	7	8	9								7		9	
21	COMMON RAVEN			3		5	6	7	8								6		8	9	
22	BLACK HAWK			3		5	6	7	8											9	
23	LONG-BILLED MARSH WREN			3		5	6			9											10
24	BOBCAT			3		5	6									5	6				
25	LEAST BITTERN			3		5	6														10
26	BLACK PHOEBE			3		5				9							6				
27	LEOPARD FROG			3		5									4						
28	GRAY FOX			3		5										5	6		8		
29	WESTERN SPOTTED SKUNK			3		5										5	6				
30	CINNAMON TEAL			3		5											6				
31	NORTHERN WATERTHRUSH			3		5															10
	BALD EAGLE			3		5															10
32	NORTHERN SHOVELER			3																	10
	SPOTTED SANDPIPER			3																	10
	DIPPER			3																	10
	BELTED KINGFISHER			3																	10
33	RINGTAIL				4	5	6		8							5	6		8		
34	GOPHER SNAKE				4	5	6									5	6				
	STRIPED WHIPSNAKE				4	5	6									5	6				

Table 33. (continued).

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
35	LONG-NOSED SNAKE				4	5										5	6				
	WESTERN BLIND SNAKE				4	5										5	6				
	GLOSSY SNAKE				4	5										5	6				
	COLLARED PECCARY				4	5										5	6				
	MEXICAN BLACK-HEADED SNAKE				4	5										5	6				
	WESTERN PATCH-NOSED SNAKE				4	5										5	6				
	BLACK BEAR				4	5										5	6				
	GILBERT'S SKINK				4	5										5	6				
36	CORAL SNAKE				4	5										5					
37	GREAT HORNED OWL					5	6	7	8	9						5	6		8	9	
38	COMMON FLICKER					5	6	7	8	9						5			8		
39	COSTA'S HUMMINGBIRD					5	6	7	8	9							6	7		9	
	BLACK-CHINNED HUMMINGBIRD					5	6	7	8	9							6	7		9	
	BROAD-TAILED HUMMINGBIRD					5	6	7	8	9							6	7		9	
40	AMERICAN KESTREL					5	6	7	8	9							6		8		
41	NORTHERN ORIOLE					5	6	7	8	9								7		9	
	HOODED ORIOLE					5	6	7	8	9								7		9	
	YELLOW WARBLER					5	6	7	8	9								7		9	
	WARBLING VIREO					5	6	7	8	9								7		9	
42	BELL'S VIREO					5	6	7	8	9								7			
43	LADDER-BACKED WOODPECKER					5	6	7	8	9									8		
	WHITE-BREASTED NUTHATCH					5	6	7	8	9									8		
	GILA WOODPECKER					5	6	7	8	9									8		
	ACORN WOODPECKER					5	6	7	8	9									8		
	ELF OWL					5	6	7	8	9									8		
44	ANNA'S HUMMINGBIRD					5	6	7	8	9											10
	CALLIOPE HUMMINGBIRD					5	6	7	8	9											10
	RUFOUS HUMMINGBIRD					5	6	7	8	9											10
	GRAY VIREO					5	6	7	8	9											10
	RUBY-CROWNED KINGLET					5	6	7	8	9											10
	PYGMY NUTHATCH					5	6	7	8	9											10
	LEWIS' WOODPECKER					5	6	7	8	9											10
	YELLOW-RUMPED WARBLER					5	6	7	8	9											10
	CLARK'S NUTCRACKER					5	6	7	8	9											10
	GOLDEN-CROWNED KINGLET					5	6	7	8	9											10

Table 33. (continued).

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
45	WESTERN HARVEST MOUSE					5	6	7	8								6	7	8		
46	BEWICK'S WREN					5	6	7	8								6		8		
	HOUSE WREN					5	6	7	8								6		8		
47	SCRUB JAY					5	6	7	8									7		9	
	STELLER'S JAY					5	6	7	8									7		9	
48	PYGMY OWL					5	6	7	8										8		
49	ZONE-TAILED HAWK					5	6	7	8											9	
50	BLACK-THROATED GRAY WARBLER					5	6	7	8												10
	ORANGE-CROWNED WARBLER					5	6	7	8												10
	SHARP-SHINNED HAWK					5	6	7	8												10
51	DESERT SPINY LIZARD					5	6	7								5	6				
	ROCK WREN					5	6	7								5	6				
	CANYON WREN					5	6	7								5	6				
52	PALLID BAT					5	6		8	9						5	6		8		
53	FRINGED MYOTIS					5	6		8	9						5	6				
54	WILLOW FLYCATCHER					5	6		8	9							6	7			
55	RED-FACED WARBLER					5	6		8	9							6				
56	BLUE-GRAY GNATCATCHER					5	6		8	9								7		9	
57	ASH-THROATED FLYCATCHER					5	6		8	9									8		
	WIED'S CRESTED FLYCATCHER					5	6		8	9									8		
	RED BAT					5	6		8	9									8		
58	WESTERN FLYCATCHER					5	6		8	9											10
	LEAST FLYCATCHER					5	6		8	9											10
	HAMMOND'S FLYCATCHER					5	6		8	9											10
	DUSKY FLYCATCHER					5	6		8	9											10
	GRAY FLYCATCHER					5	6		8	9											10
59	CACTUS WREN					5	6		8								6	7	8	9	
60	LAZULI BUNTING					5	6		8								6	7			

Table 33. (continued).

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
61	BLACK-HEADED GROSBEAK					5	6		8									7			
	BLUE GROSBEAK					5	6		8									7			
62	SCREECH OWL					5	6		8										8		
63	VIRGINIA'S WARBLER					5	6			9							6				
	PAINTED REDSTART					5	6			9							6				
64	WESTERN BLUEBIRD					5	6			9									8		
65	WILSON'S WARBLER					5	6			9											10
	PINON JAY					5	6			9											10
	SWAINSON'S THRUSH					5	6			9											10
	TOWNSEND'S SOLITAIRE					5	6			9											10
	LUCY'S WARBLER					5	6			9											10
	MOUNTAIN BLUEBIRD					5	6			9											10
66	CALIFORNIA KING SNAKE					5	6									5	6				
	SONORA WHIPSNAKE					5	6									5	6				
	DEER MOUSE					5	6									5	6				
	COACHWHIP					5	6									5	6				
	MOUNTAIN LION					5	6									5	6				
67	BROWN-HEADED COWBIRD					5	6										6	7		9	
68	YELLOW-BREASTED CHAT					5	6										6	7			
	COMMON YELLOWTHROAT					5	6										6	7			
	CRISSAL THRASHER					5	6										6	7			
69	SOUTHERN PLATEAU LIZARD					5	6										6				
70	HERMIT THRUSH					5	6											7			
	CARDINAL					5	6											7			
71	GREEN-TAILED TOWHEE					5	6														10
	MACGILLIVRAY'S WARBLER					5	6														10
72	BROWN CREEPER					5		7													10
73	SMALL-FOOTED MYOTIS					5				9						5	6				
	SAY'S PHOEBE					5				9						5	6				
74	WESTERN KINGBIRD					5				9								7	8	9	
	CASSIN'S KINGBIRD					5				9								7	8	9	

Table 33. (continued).

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
75	WESTERN WOOD PEWEE					5				9								7		9	
	VERMILION FLYCATCHER					5				9								7		9	
76	COLORADO RIVER TOAD					5								3							
77	SOUTHWEST TOAD					5									4						
	COUCH'S SPADEFOOT TOAD					5									4						
	CANYON TREE FROG					5									4						
	RED-SPOTTED TOAD					5									4						
78	CLIFF CHIPMUNK					5										5	6		8		
79	SIDE-BLOTCHED LIZARD					5										5	6				
	BRUSH MOUSE					5										5	6				
	ZEBRA-TAILED LIZARD					5										5	6				
	WESTERN DIAMONDBACK RATTLESNAKE					5										5	6				
	MOHAVE RATTLESNAKE					5										5	6				
	GREATER EARLESS LIZARD					5										5	6				
	CACTUS MOUSE					5										5	6				
80	HARRIS' ANTELOPE SQUIRREL					5										5					
81	AMERICAN ROBIN					5											6	7		9	
82	ROADRUNNER					5											6	7			
83	RED-TAILED HAWK					5											6		8	9	
84	KILLDEER					5											6				
	HOUSE MOUSE					5											6				
	TURKEY VULTURE					5											6				
	SPOTTED LEAF-NOSE SNAKE					5											6				
	DESERT SHREW					5											6				
	CALIFORNIA WHIPTAIL					5											6				
	RUFOUS-SIDED TOWHEE					5											6				
	ROCK SQUIRREL					5											6				
	GAMBEL'S QUAIL					5											6				
85	CHIPPING SPARROW					5															10
	WHITE-CROWNED SPARROW					5															10
	WATER PIPIT					5															10
	FOX SPARROW					5															10
	LINCOLN'S SPARROW					5															10
	DARK-EYED JUNCO					5															10

Table 33. (continued).

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
86	SUMMER TANAGER						6	7	8	9								7		9	
	SOLITARY VIREO						6	7	8	9								7		9	
87	GRACE'S WARBLER						6	7	8	9										9	
88	HERMIT WARBLER						6	7	8	9											10
	WESTERN TANAGER						6	7	8	9											10
	DOWNY WOODPECKER						6	7	8	9											10
	YELLOW-BELLIED SAPSUCKER						6	7	8	9											10
	HAIRY WOODPECKER						6	7	8	9											10
	AMERICAN REDSTART						6	7	8	9											10
	CEDAR WAXWING						6	7	8	9											10
89	BUSHTIT						6	7	8									7		9	
90	VERDIN						6	7	8									7			
91	BRIDLED TITMOUSE						6	7	8										8		
	PLAIN TITMOUSE						6	7	8										8		
92	RED-BREASTED NUTHATCH						6	7	8												10
	WILLIAMSON'S SAPSUCKER						6	7	8												10
	PHAINOPEPLA						6	7	8												10
	TOWNSEND'S WARBLER						6	7	8												10
93	TREE LIZARD						6	7									6				
	LONG-TAIL BRUSH LIZARD						6	7									6				
94	LONG-EARED MYOTIS						6		8	9							6		8		
95	YELLOW-BILLED CUCKOO						6		8									7		9	
96	LITTLE BROWN MYOTIS									9						5	6		8		
	YUMA MYOTIS									9						5	6		8		
	BIG BROWN BAT									9						5	6		8		
	LONG-LEGGED MYOTIS									9						5	6		8		
97	CAVE MYOTIS									9						5	6				
	CALIFORNIA MYOTIS									9						5	6				
	TOWNSEND'S BIG-EARED BAT									9						5	6				
	WHITE-THROATED SWIFT									9						5	6				
	SPOTTED BAT									9						5	6				
	BRAZILIAN FREE-TAILED BAT									9						5	6				

Table 33. (concluded).

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
98	ROUGH-WINGED SWALLOW									9						5					
99	CLIFF SWALLOW									9							6				
100	VIOLET-GREEN SWALLOW									9									8		
101	HOARY BAT									9											10
	VAUX'S SWIFT									9											10
	BLACK SWIFT									9											10
	BARN SWALLOW									9											10
	PURPLE MARTIN									9											10
	TREE SWALLOW									9											10
102	BARN OWL										10					5	6		8		
103	LONG-EARED OWL										10									9	

Table 34. Effects of habitat alterations on primary consumer and secondary consumer guilds in mixed broad leaf riparian habitats (total of 159 guilds).

Impacted guilds	Impacted system or layer of habitat				
	Aquatic	Understory	Midstory	Tree bole	Overstory
Deleterious impacts					
Primary consumers[a]	3-8, 13	1, 8, 11, 27, 40, 44-49	30, 41, 53	21, 31, 54, 56	32
Secondary consumers[b]	5-10, 13, 15-16, 27, 32, 76-77	2, 14, 16-17, 26, 30, 55, 63, 69, 75-85, 93	42, 61, 70, 90	43, 48, 57, 62, 64, 91, 100	22, 49, 87, 103
Totals	20 guilds (21 species)	32 guilds (59 species)	7 guilds (6 species)	11 guilds (14 species)	5 guilds (5 species)
Adverse impacts					
Primary consumers[a]	1-2, 9-12	2, 9-10, 12, 14-26, 28-39, 41-42, 51	9-10, 14-16, 19-29, 31-40, 42, 46, 50-52, 54-55	9, 14, 19-20, 22-25, 28, 37, 44, 47, 50	9, 14-15, 19-31, 33, 37-38, 43, 46-47, 50-55
Secondary consumers[b]	1-4, 11-12, 14, 17-26, 28-31	c	3, 8, 11, 18, 20-25, 33-34, 37-41, 43-60, 62-69, 71, 74-75, 81-82, 86-89, 91-95	8, 11, 20-22, 28, 33, 37-42, 44-47, 49-52, 59, 72, 74, 78, 83, 86-90, 92-94, 96, 102	1, 3, 11, 20-21, 33, 37-48, 50, 52-62, 67, 74-75, 81, 83, 86, 88-92, 94-95
Totals	27 guilds (31 species)	32+ guilds (61+ species)	90 guilds (136 species)	49 guilds (73 species)	71 guilds (103 species)

[a]See Table 32 for a list of species in each identified primary consumer guild.

[b]See Table 33 for a list of species in each identified secondary consumer guild.

[c]Additional guilds of secondary consumers will be adversely affected because of changes in their food chains due to the reduced biomass of primary consumers.

Mixed Riparian Scrub Habitat

This habitat occurs throughout the Sonoran Desert as strips or bottoms of scrub along arroyos and drainages that have an elevated water table. The three layers of habitat present include a midstory with a shrub cover that is of greater density than in the surrounding lower Sonoran Desert types, a surface layer where the density of vegetation cover is quite variable, and a subsurface layer. The primary production of seeds and forage may be greater in this riparian scrub habitat then in neighboring cover types, even though water is only intermittently present in these drainages. Potential species richness in the mixed riparian scrub habitat is greater than in surrounding creosote bush-white bursage and joshua tree-creosote bush habitats but less than in higher elevation chaparral, juniper-pinyon, and juniper-mixed shrub habitats (Appendix II). The 161 vertebrate species potentially present in mixed riparian scrub habitats are arrayed into 20 guilds of primary consumers (Table 35) and 31 guilds of secondary consumers (Table 36).

Heavy grazing of understory vegetation in mixed riparian scrub habitats will deleteriously impact seven guilds of primary consumers and eight guilds of secondary consumers (Table 37). In addition, 11 guilds of primary consumers will be adversely impacted. Several guilds of secondary consumers will also be adversely affected because their food chains will be modified due to reduced biomass of some primary consumer species.

Removal of the shrub midstory canopy in washes and drainages containing riparian scrub vegetation will deleteriously impact five guilds of primary consumers and six guilds of secondary consumers. Nine guilds of primary consumers and 11 guilds of secondary consumers (Table 37) will be adversely impacted.

The best management of this habitat for wildlife involves restricting the use of current vegetation production to levels that will not deleteriously affect the structure of the habitat layers present in this community. In addition, management should prevent other activities, like wide-scale mechanical clearing or herbicidal treatments, from destroying the structure of the midstory in this cover type.

Table 35. Wildlife guilds of primary consumers in mixed riparian scrub habitats in westcentral Arizona. The interpretation of the table is as in Table 5.

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
1	COLLARED PECCARY				4	5	6									5	6				
	COYOTE				4	5	6									5	6				
	PORCUPINE				4	5	6									5	6				
	CACTUS MOUSE				4	5	6									5	6				
2	STRIPED SKUNK				4	5										5	6				
3	BOTTA'S POCKET GOPHER				4	5										5					
4	WHITE-THROATED WOODRAT					5	6									5	6	7			
5	RINGTAIL					5	6									5	6				
	GRAY FOX					5	6									5	6				
6	COMMON FLICKER					5	6									5		7			
7	ROUND-TAILED GROUND SQUIRREL					5	6									5					
	HARRIS' ANTELOPE SQUIRREL					5	6									5					
	STARLING					5	6									5					
8	CACTUS WREN					5	6										6	7			
	WESTERN HARVEST MOUSE					5	6										6	7			
	CURVE-BILLED THRASHER					5	6										6	7			
	MOCKINGBIRD					5	6										6	7			
	BENDIRE'S THRASHER					5	6										6	7			
	BROWN-HEADED COWBIRD					5	6										6	7			
	BLACK-CHINNED HUMMINGBIRD					5	6										6	7			
	HOUSE FINCH					5	6										6	7			
	COSTA'S HUMMINGBIRD					5	6										6	7			
	CRISSAL THRASHER					5	6										6	7			
9	MULE DEER					5	6										6				
	ROCK SQUIRREL					5	6										6				
	BURRO					5	6										6				
	CATTLE					5	6										6				
10	LADDER-BACKED WOODPECKER					5	6											7			
	GILA WOODPECKER					5	6											7			
	CARDINAL					5	6											7			
	WESTERN KINGBIRD					5	6											7			

Table 35. (continued).

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
11	SWAINSON'S THRUSH					5	6														10
	SAGE THRASHER					5	6														10
	SCOTT'S ORIOLE					5	6														10
	GREEN-TAILED TOWHEE					5	6														10
	BLACK-HEADED GROSBEAK					5	6														10
	BUSHTIT					5	6														10
	BIGHORN SHEEP					5	6														10
	AMERICAN ROBIN					5	6														10
	BLUE GROSBEAK					5	6														10
	YELLOW-RUMPED WARBLER					5	6														10
	RUBY-CROWNED KINGLET					5	6														10
	LEWIS' WOODPECKER					5	6														10
	WESTERN BLUEBIRD					5	6														10
	LAZULI BUNTING					5	6														10
	MOUNTAIN BLUEBIRD					5	6														10
	ANNA'S HUMMINGBIRD					5	6														10
	HERMIT THRUSH					5	6														10
	LESSER GOLDFINCH					5	6														10
12	CANYON MOUSE					5										5	6				
	WESTERN SPOTTED SKUNK					5										5	6				
	ARIZONA WOODRAT					5										5	6				
13	MERRIAM'S KANGAROO RAT					5										5					
	BAILEY'S POCKET MOUSE					5										5					
	ARIZONA POCKET MOUSE					5										5					
	ROCK POCKET MOUSE					5										5					
	DESERT POCKET MOUSE					5										5					
	SOUTHERN GRASSHOPPER MOUSE					5										5					
14	MOURNING DOVE					5											6	7			
15	COMMON RAVEN					5											6				
	HOUSE MOUSE					5											6				
	GAMBEL'S QUAIL					5											6				
	BLACK-TAILED JACK RABBIT					5											6				
	ROCK DOVE					5											6				
	DESERT COTTONTAIL					5											6				
16	BLACK-THROATED SPARROW					5												7			
	BROWN TOWHEE					5												7			

Table 35. (concluded).

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
17	TREE SWALLOW					5															10
	LARK SPARROW					5															10
	CHIPPING SPARROW					5															10
	DARK-EYED JUNCO					5															10
	LINCOLN'S SPARROW					5															10
	BREWER'S SPARROW					5															10
	SAGE SPARROW					5															10
	WHITE-CROWNED SPARROW					5															10
	WATER PIPIT					5															10
18	SAY'S PHOEBE						6										5	6			
19	VERDIN						6											7			
	ASH-THROATED FLYCATCHER						6											7			
	PHAINOPEPLA						6											7			
	WIED'S CRESTED FLYCATCHER						6											7			
	HOODED ORIOLE						6											7			
20	NORTHERN ORIOLE						6														10
	WARBLING VIREO						6														10
	YELLOW-BELLIED SAPSUCKER						6														10
	HERMIT WARBLER						6														10

Table 36. Wildlife guilds of secondary consumers in mixed riparian scrub habitats in westcentral Arizona. The interpretation of the table is as in Table 5.

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
1	RINGTAIL				4	5	6									5	6				
	GOPHER SNAKE				4	5	6									5	6				
	COYOTE				4	5	6									5	6				
2	COLLARED PECCARY				4	5										5	6				
	MEXICAN BLACK-HEADED SNAKE				4	5										5	6				
	CORAL SNAKE				4	5										5	6				
	WESTERN BLIND SNAKE				4	5										5	6				
	GLOSSY SNAKE				4	5										5	6				
	STRIPED SKUNK				4	5										5	6				
	WESTERN PATCH-NOSED SNAKE				4	5										5	6				
	LONG-NOSED SNAKE				4	5										5	6				
3	BADGER				4	5															10
4	CALIFORNIA LEAF-NOSED BAT					5	6			9						5	6				
	GREAT HORNED OWL					5	6			9						5	6				
	PALLID BAT					5	6			9						5	6				
5	COMMON FLICKER					5	6			9						5		7			
6	STARLING					5	6			9						5					
7	BLACK-CHINNED HUMMINGBIRD					5	6			9							6	7			
	BLACK-TAILED GNATCATCHER					5	6			9							6	7			
	COSTA'S HUMMINGBIRD					5	6			9							6	7			
8	HOODED ORIOLE					5	6			9								7			
	ASH-THROATED FLYCATCHER					5	6			9								7			
	WIED'S CRESTED FLYCATCHER					5	6			9								7			
	GILA WOODPECKER					5	6			9								7			
	LOGGERHEAD SHRIKE					5	6			9								7			
	LADDER-BACKED WOODPECKER					5	6			9								7			

Table 36. (continued).

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
9	YELLOW-RUMPED WARBLER					5	6			9											10
	VIRGINIA'S WARBLER					5	6			9											10
	ELF OWL					5	6			9											10
	YELLOW WARBLER					5	6			9											10
	SWAINSON'S THRUSH					5	6			9											10
	WESTERN BLUEBIRD					5	6			9											10
	COOPER'S HAWK					5	6			9											10
	WILSON'S WARBLER					5	6			9											10
	SCOTT'S ORIOLE					5	6			9											10
	NORTHERN ORIOLE					5	6			9											10
	GRAY FLYCATCHER					5	6			9											10
	LEAST FLYCATCHER					5	6			9											10
	LUCY'S WARBLER					5	6			9											10
	LEWIS' WOODPECKER					5	6			9											10
	DUSKY FLYCATCHER					5	6			9											10
	BLUE-GRAY GNATCATCHER					5	6			9											10
	HAMMOND'S FLYCATCHER					5	6			9											10
	WILLOW FLYCATCHER					5	6			9											10
	WESTERN FLYCATCHER					5	6			9											10
	WARBLING VIREO					5	6			9											10
	MOUNTAIN BLUEBIRD					5	6			9											10
	RUBY-CROWNED KINGLET					5	6			9											10
	ANNA'S HUMMINGBIRD					5	6			9											10
10	CALIFORNIA KING SNAKE					5	6									5	6				
	COACHWHIP					5	6									5	6				
	ROCK WREN					5	6									5	6				
	CANYON WREN					5	6									5	6				
11	WESTERN HARVEST MOUSE					5	6										6	7			
	BROWN-HEADED COWBIRD					5	6										6	7			
	BENDIRE'S THRASHER					5	6										6	7			
	MOCKINGBIRD					5	6										6	7			
	CURVE-BILLED THRASHER					5	6										6	7			
	CACTUS WREN					5	6										6	7			
	CRISSAL THRASHER					5	6										6	7			
12	COMMON RAVEN					5	6										6				
	TREE LIZARD					5	6										6				
	LONG-TAIL BRUSH LIZARD					5	6										6				
	AMERICAN KESTREL					5	6										6				
13	CARDINAL					5	6											7			
	SCREECH OWL					5	6											7			

Table 36. (continued).

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
14	BOBCAT					5	6														10
	GREEN-TAILED TOWHEE					5	6														10
	BLACK-THROATED GRAY WARBLER					5	6														10
	ORANGE-CROWNED WARBLER					5	6														10
	BEWICK'S WREN					5	6														10
	BLUE GROSBEAK					5	6														10
	MACGILLIVRAY'S WARBLER					5	6														10
	MOUNTAIN LION					5	6														10
	HERMIT THRUSH					5	6														10
	LAZULI BUNTING					5	6														10
	BLACK-HEADED GROSBEAK					5	6														10
	SAGE THRASHER					5	6														10
	COMMON YELLOWTHROAT					5	6														10
	SHARP-SHINNED HAWK					5	6														10
15	SAY'S PHOEBE					5				9							5	6			
16	WESTERN KINGBIRD					5				9									7		
17	LESSER NIGHTHAWK					5				9											10
	VERMILION FLYCATCHER					5				9											10
18	COUCH'S SPADEFOOT TOAD					5							1								
19	CACTUS MOUSE					5											5	6			
	GRAY FOX					5											5	6			
	BARN OWL					5											5	6			
	WESTERN SPOTTED SKUNK					5											5	6			
	GREATER EARLESS LIZARD					5											5	6			
	CANYON MOUSE					5											5	6			
	ZEBRA-TAILED LIZARD					5											5	6			
	SIDE-BLOTCHED LIZARD					5											5	6			
	WESTERN DIAMONDBACK RATTLESNAKE					5											5	6			
	MOHAVE RATTLESNAKE					5											5	6			
20	MERRIAM'S KANGAROO RAT					5											5				
	ROUND-TAILED GROUND SQUIRREL					5											5				
	HARRIS' ANTELOPE SQUIRREL					5											5				
	SOUTHERN GRASSHOPPER MOUSE					5											5				
21	ROADRUNNER					5												6	7		

Table 36. (continued).

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
22	CHECKERED GARTER SNAKE					5											6				
	BLACK-NECKED GARTER SNAKE					5											6				
	TURKEY VULTURE					5											6				
	SPOTTED LEAF-NOSE SNAKE					5											6				
	ROCK SQUIRREL					5											6				
	DESERT SHREW					5											6				
	HOUSE MOUSE					5											6				
	GAMBEL'S QUAIL					5											6				
	CALIFORNIA WHIPTAIL					5											6				
	RED-TAILED HAWK					5											6				
23	BROWN TOWHEE					5												7			
24	CHIPPING SPARROW					5															10
	DARK-EYED JUNCO					5															10
	WHITE-CROWNED SPARROW					5															10
	BREWER'S SPARROW					5															10
	LARK SPARROW					5															10
	SAGE SPARROW					5															10
	WATER PIPIT					5															10
	LINCOLN'S SPARROW					5															10
	AMERICAN ROBIN					5															10
25	WESTERN TANAGER						6			9											10
	YELLOW-BELLIED SAPSUCKER						6			9											10
	SOLITARY VIREO						6			9											10
	HERMIT WARBLER						6			9											10
26	PHAINOPEPLA						6											7			
	VERDIN						6											7			
27	TOWNSEND'S WARBLER						6														10
	BUSHTIT						6														10

Table 36. (concluded).

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
28	BIG BROWN BAT									9						5	6				
	CALIFORNIA MYOTIS									9						5	6				
	BRAZILIAN FREE-TAILED BAT									9						5	6				
	CAVE MYOTIS									9						5	6				
	WESTERN PIPISTRELLE									9						5	6				
	TOWNSEND'S BIG-EARED BAT									9						5	6				
	WHITE-THROATED SWIFT									9						5	6				
29	ROUGH-WINGED SWALLOW									9						5					
30	CLIFF SWALLOW									9							6				
31	BARN SWALLOW									9											10
	VIOLET-GREEN SWALLOW									9											10
	TREE SWALLOW									9											10
	VAUX'S SWIFT									9											10
	BLACK SWIFT									9											10

Table 37. Effects of habitat alterations on primary consumer and secondary consumer guilds in mixed riparian scrub habitats (total of 51 guilds).

Impacted guilds	Impacted system or layer of habitat				
	Aquatic	Understory	Midstory	Tree bole	Overstory
Deleterious impacts					
Primary consumers[a]		9, 12-17	10, 16, 18-20		
Secondary consumers[b]		12, 18-24	8, 13, 16, 23, 26-27		
Totals		15 guilds (54 species)	11 guilds (20 species)		
Adverse impacts					
Primary consumers[a]		1-8, 10-11, 18	1, 4-9, 11, 14		
Secondary consumers[b]		c	1, 4-7, 9-12, 14, 21		
Totals		11+ guilds (46+species)	20 guilds (84 species)		

[a]See Table 35 for a list of species in each identified primary consumer guild.

[b]See Table 36 for a list of species in each identified secondary consumer guild.

[c]Additional guilds of secondary consumers will be adversely affected because of changes in their food chains due to the reduced biomass of primary consumers.

Ponderosa Pine Habitat

Small areas of Kuchler's (1964) PNVT 19, Arizona pine forest, amounting to less than 0.3% of the total planning units (Millsap 1981), occur in the Hualapai Mountains. Ponderosa pine (Pinus ponderosa) and gambel oak are the dominant overstory components in this habitat, and a variety of woody browse plants occur in the midstory. The grass understory varies in percent cover, depending on the density of the tree overstory. Mature ponderosa pine habitats provide subsurface, surface, midstory, tree bole, and tree canopy layers of habitat. Note the guild blocks used by wildlife in this habitat type (Fig. 15). Ponderosa pine habitats, which occur at elevations of 6,500-7,500 ft (Jones 1981), are potential breeding and/or feeding habitat for 154 vertebrate species (Appendix II). These species are arrayed into 39 guilds of primary consumers (Table 38) and 62 guilds of secondary consumers (Table 39).

Heavy grazing of surface vegetation in areas where it is plentiful will deleteriously impact nine guilds of primary consumers and 11 guilds of secondary consumers (Table 40). Twenty-four guilds of primary consumers will be adversely affected. Other guilds of secondary consumers will also be adversely affected if limited surface vegetation reduces the biomass of primary consumers, thereby impacting the food chains of secondary consumers.

Extensive disturbance of the midstory layer under the pine canopy will deleteriously impact three species (black-headed grosbeak, blue grosbeak, and hermit thrush), which comprise two guilds of primary consumers and two guilds

of secondary consumers. In addition, 28 guilds of primary consumers and 43 guilds of secondary consumers will be adversely impacted (Table 40).

Removal of large tree boles and snags will deleteriously impact four guilds of primary consumers and six guilds of secondary consumers. Eleven guilds of primary consumers and 28 guilds of secondary consumers will be adversely affected (Table 40).

Destruction of the tree canopy through large scale clearcutting, crown fires, or insect devastation will deleteriously impact one primary consumer guild and four guilds of secondary consumers. Twenty-four guilds of primary consumers and 34 guilds of secondary consumers will be adversely affected.

Pine forests need to be periodically thinned to increase the production of midstory and understory plants useful for wildlife. Regeneration efforts that scatter small clearcuts throughout the forest will also provide different seral stages of forest succession, while maintaining large blocks of forest in a mature tree stage. These conditions maximize species richness within a unit of pine forest.

Table 38. Wildlife guilds of primary consumers in ponderosa pine habitats in westcentral Arizona. The interpretation of the table is as in Table 5.

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
1	BLACK BEAR				4	5	6	7	8							5	6				
2	PORCUPINE				4	5	6		8							5	6				
3	DEER MOUSE				4	5	6									5	6				
	COYOTE				4	5	6									5	6				
4	MEXICAN VOLE				4	5										5	6				
	STRIPED SKUNK				4	5										5	6				
	HOG-NOSED SKUNK				4	5										5	6				
5	BOTTA'S POCKET GOPHER				4	5										5					
6	COMMON FLICKER					5	6	7	8							5			8		
7	BROAD-TAILED HUMMINGBIRD					5	6	7	8								6	7		9	
8	ACORN WOODPECKER					5	6	7	8										8		
9	RUFOUS HUMMINGBIRD					5	6	7	8												10
	YELLOW-RUMPED WARBLER.					5	6	7	8												10
	CALLIOPE HUMMINGBIRD					5	6	7	8												10
	ANNA'S HUMMINGBIRD					5	6	7	8												10
10	RACCOON					5	6		8							5	6	7	8		
11	LESSER GOLDFINCH					5	6		8								6	7		9	
12	ROCK SQUIRREL					5	6		8								6				
13	CASSIN'S KINGBIRD					5	6		8									7	8	9	
14	BUSHTIT					5	6		8									7		9	
	PINON JAY					5	6		8									7		9	
	SCRUB JAY					5	6		8									7		9	
	STELLER'S JAY					5	6		8									7		9	
15	BLACK-HEADED GROSBEAK					5	6		8									7			
16	WESTERN BLUEBIRD					5	6		8										8		
17	ABERT'S SQUIRREL					5	6		8											9	
	BAND-TAILED PIGEON					5	6		8											9	

Table 38. (continued).

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
18	TOWNSEND'S SOLITAIRE					5	6		8												10
	MOUNTAIN BLUEBIRD					5	6		8												10
	RUBY-CROWNED KINGLET					5	6		8												10
	LEWIS' WOODPECKER					5	6		8												10
	CLARK'S NUTCRACKER					5	6		8												10
	AMERICAN ROBIN					5	6		8												10
	PINE SISKIN					5	6		8												10
19	WHITE-THROATED WOODRAT					5	6									5	6	7			
20	GRAY FOX					5	6									5	6		8		
21	STEPHENS' WOODRAT					5	6									5	6				
	BRUSH MOUSE					5	6									5	6				
	MEXICAN WOODRAT					5	6									5	6				
22	HOUSE FINCH					5	6										6	7	8	9	
23	MULE DEER					5	6										6				
	CATTLE					5	6										6				
	ELK					5	6										6				
24	HERMIT THRUSH					5	6											7			
	BLUE GROSBEAK					5	6											7			
25	LAZULI BUNTING					5	6														10
	CACTUS WREN					5	6														10
	SWAINSON'S THRUSH					5	6														10
	GREEN-TAILED TOWHEE					5	6														10
26	CASSIN'S FINCH					5			8												10
	PURPLE FINCH					5			8												10
27	CLIFF CHIPMUNK					5										5	6		8		
28	ARIZONA WOODRAT					5										5	6				
29	MOURNING DOVE					5											6	7		9	
30	COMMON RAVEN					5											6		8	9	
31	BLACK-TAILED JACK RABBIT					5											6				
	DESERT COTTONTAIL					5											6				
	ROCK DOVE					5											6				
	RUFOUS-SIDED TOWHEE					5											6				
	EASTERN COTTONTAIL					5											6				
	HOUSE MOUSE					5											6				

Table 38. (concluded).

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
32	CHIPPING SPARROW					5												7		9	
33	DARK-EYED JUNCO					5															10
	WHITE-CROWNED SPARROW					5															10
	TREE SWALLOW					5															10
34	CEDAR WAXWING						6	7	8												10
	YELLOW-BELLIED SAPSUCKER						6	7	8												10
35	SAY'S PHOEBE						6		8							5	6				
36	WARBLING VIREO						6		8									7		9	
37	PYGMY NUTHATCH						6		8										8		
	WHITE-BREASTED NUTHATCH						6		8										8		
	HAIRY WOODPECKER						6		8										8		
	PLAIN TITMOUSE						6		8										8		
	DOWNY WOODPECKER						6		8										8		
38	WESTERN TANAGER						6		8												10
	ASH-THROATED FLYCATCHER						6		8												10
	HERMIT WARBLER						6		8												10
	RED-BREASTED NUTHATCH						6		8												10
39	WILLIAMSON'S SAPSUCKER							7													10

Table 39. Wildlife guilds of secondary consumers in ponderosa pine habitats in westcentral Arizona. The interpretation of the table is as in Table 5.

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
1	COYOTE				4	5	6									5	6				
	STRIPED WHIPSNAKE				4	5	6									5	6				
2	GILBERT'S SKINK				4	5										5	6				
	BLACK BEAR				4	5										5	6				
	HOG-NOSED SKUNK				4	5										5	6				
	STRIPED SKUNK				4	5										5	6				
3	TIGER SALAMANDER				4	5															10
4	GREAT HORNED OWL					5	6	7	8	9						5	6		8	9	
5	COMMON FLICKER					5	6	7	8	9						5			8		
6	BROAD-TAILED HUMMINGBIRD					5	6	7	8	9							6	7		9	
7	SPOTTED OWL					5	6	7	8	9							6		8		
	AMERICAN KESTREL					5	6	7	8	9							6		8		
8	WHIP-POOR-WILL					5	6	7	8	9							6				
9	WARBLING VIREO					5	6	7	8	9								7		9	
	COOPER'S HAWK					5	6	7	8	9								7		9	
10	ACORN WOODPECKER					5	6	7	8	9									8		
	PYGMY NUTHATCH					5	6	7	8	9									8		
	WHITE-BREASTED NUTHATCH					5	6	7	8	9									8		
	FLAMMULATED OWL					5	6	7	8	9									8		
11	RUFOUS HUMMINGBIRD					5	6	7	8	9											10
	YELLOW-RUMPED WARBLER					5	6	7	8	9											10
	LEWIS' WOODPECKER					5	6	7	8	9											10
	RUBY-CROWNED KINGLET					5	6	7	8	9											10
	GOLDEN-CROWNED KINGLET					5	6	7	8	9											10
	CALLIOPE HUMMINGBIRD					5	6	7	8	9											10
	ANNA'S HUMMINGBIRD					5	6	7	8	9											10
	GRAY VIREO					5	6	7	8	9											10
	CLARK'S NUTCRACKER					5	6	7	8	9											10
12	COMMON RAVEN					5	6	7	8								6		8	9	

Table 39. (continued).

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
13	HOUSE WREN					5	6	7	8								6		8		
	BEWICK'S WREN					5	6	7	8								6		8		
14	SCRUB JAY					5	6	7	8									7		9	
	STELLER'S JAY					5	6	7	8									7		9	
15	PYGMY OWL					5	6	7	8										8		
16	SHARP-SHINNED HAWK					5	6	7	8											9	
	ZONE-TAILED HAWK					5	6	7	8											9	
17	BLACK-THROATED GRAY WARBLER					5	6	7	8												10
	ORANGE-CROWNED WARBLER					5	6	7	8												10
18	ROCK WREN					5	6	7								5	6				
19	GOSHAWK					5	6	7												9	
20	PALLID BAT					5	6		8	9						5	6		8		
21	FRINGED MYOTIS					5	6		8	9						5	6				
22	RED-FACED WARBLER					5	6		8	9							6				
23	BLUE-GRAY GNATCATCHER					5	6		8	9								7		9	
24	RED BAT					5	6		8	9									8		
25	HAMMOND'S FLYCATCHER					5	6		8	9											10
	LEAST FLYCATCHER					5	6		8	9											10
	ASH-THROATED FLYCATCHER					5	6		8	9											10
	WILLOW FLYCATCHER					5	6		8	9											10
	DUSKY FLYCATCHER					5	6		8	9											10
	GRAY FLYCATCHER					5	6		8	9											10
	WESTERN FLYCATCHER					5	6		8	9											10
26	RACCOON					5	6		8							5	6	7	8		
27	BLACK-HEADED GROSBEAK					5	6		8									7			
	BLUE GROSBEAK					5	6		8									7			
28	CACTUS WREN					5	6		8												10
	LAZULI BUNTING					5	6		8												10

Table 39. (continued).

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
29	VIRGINIA'S WARBLER					5	6			9							6				
	PAINTED REDSTART					5	6			9							6				
30	PINON JAY					5	6			9								7		9	
31	WESTERN BLUEBIRD					5	6			9									8		
32	TOWNSEND'S SOLITAIRE					5	6			9											10
	WILSON'S WARBLER					5	6			9											10
	SWAINSON'S THRUSH					5	6			9											10
	MOUNTAIN BLUEBIRD					5	6			9											10
33	BOBCAT					5	6									5	6				
	DEER MOUSE					5	6									5	6				
	MOUNTAIN LION					5	6									5	6				
34	SOUTHERN PLATEAU LIZARD					5	6										6				
35	HERMIT THRUSH					5	6											7			
36	GREEN-TAILED TOWHEE					5	6														10
	MACGILLIVRAY'S WARBLER					5	6														10
37	BROWN CREEPER					5		7													10
38	SAY'S PHOEBE					5				9						5	6				
	SMALL-FOOTED MYOTIS					5				9						5	6				
39	COMMON NIGHTHAWK					5				9							6				
40	CASSIN'S KINGBIRD					5				9								7	8	9	
41	WESTERN WOOD PEWEE					5				9								7		9	
42	GRAY FOX					5										5	6		8		
	CLIFF CHIPMUNK					5										5	6		8		
43	BRUSH MOUSE					5										5	6				
	MOUNTAIN KING SNAKE					5										5	6				
	ARIZONA BLACK RATTLESNAKE					5										5	6				
44	RED-TAILED HAWK					5											6		8	9	

Table 39. (continued).

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
45	ROCK SQUIRREL					5											6				
	GOLDEN EAGLE					5											6				
	CALIFORNIA WHIPTAIL					5											6				
	PRAIRIE FALCON					5											6				
	RUFOUS-SIDED TOWHEE					5											6				
	SHORT-HORNED LIZARD					5											6				
	TURKEY VULTURE					5											6				
	HOUSE MOUSE					5											6				
46	CHIPPING SPARROW					5												7		9	
47	DARK-EYED JUNCO					5															10
	SOUTHWEST TOAD					5															10
	AMERICAN ROBIN					5															10
	WHITE-CROWNED SPARROW					5															10
48	SOLITARY VIREO						6	7	8	9								7		9	
49	HAIRY WOODPECKER						6	7	8	9									8		
	DOWNY WOODPECKER						6	7	8	9									8		
50	HEPATIC TANAGER						6	7	8	9										9	
	GRACE'S WARBLER						6	7	8	9										9	
51	CEDAR WAXWING						6	7	8	9											10
	WESTERN TANAGER						6	7	8	9											10
	YELLOW-BELLIED SAPSUCKER						6	7	8	9											10
	HERMIT WARBLER						6	7	8	9											10
52	BUSHTIT						6	7	8									7		9	
53	PLAIN TITMOUSE						6	7	8										8		
54	TOWNSEND'S WARBLER						6	7	8												10
	WILLIAMSON'S SAPSUCKER						6	7	8												10
	RED-BREASTED NUTHATCH						6	7	8												10
55	LONG-EARED MYOTIS						6		8	9							6		8		
56	LONG-LEGGED MYOTIS									9						5	6		8		
	BIG BROWN BAT									9						5	6		8		
	LITTLE BROWN MYOTIS									9						5	6		8		
	YUMA MYOTIS									9						5	6		8		

Table 39. (concluded).

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
57	WHITE-THROATED SWIFT									9						5	6				
	CALIFORNIA MYOTIS									9						5	6				
	TOWNSEND'S BIG-EARED BAT									9						5	6				
	SPOTTED BAT									9						5	6				
	BRAZILIAN FREE-TAILED BAT									9						5	6				
	CAVE MYOTIS									9						5	6				
58	PURPLE MARTIN									9						5			8		
59	ROUGH-WINGED SWALLOW									9						5					
60	CLIFF SWALLOW									9							6				
61	VIOLET-GREEN SWALLOW									9											10
	HOARY BAT									9											10
	TREE SWALLOW									9											10
	BARN SWALLOW									9											10
	BLACK SWIFT									9											10
	VAUX'S SWIFT									9											10
62	LONG-EARED OWL										10									9	

Table 40. Effects of habitat alterations on primary consumer and secondary consumer guilds in ponderosa pine habitats (total of 101 guilds).

Impacted guilds	Impacted system or layer of habitat				
	Aquatic	Understory	Midstory	Tree bole	Overstory
Deleterious impacts					
Primary consumers[a]		12, 23, 27-33	15, 24	8, 16, 37, 39	17
Secondary consumers[b]		8, 22, 29, 34, 39, 42-47	27, 35	10, 15, 24, 31, 49, 53	16, 19, 50, 62
Totals		20 guilds (36 species)	4 guilds (3 species)	10 guilds (11 species)	5 guilds (8 species)
Adverse impacts					
Primary consumers[a]		1-11, 13-22, 24-25, 35	1-3, 6-14, 16-23, 25, 29, 32, 34-38	1, 6-7, 9-10, 13, 20, 22, 27, 30, 34	1-2, 6-16, 18, 22, 26, 29-30, 32, 34-38
Secondary consumers[b]		c	1, 4-26, 28-34, 36, 40-41, 46, 48-55	4-9, 11-14, 16-20, 26, 37, 40, 42, 44, 48, 50-52, 54-56, 58	4-15, 17, 20-28, 30, 40-41, 44, 46, 48-49, 51-55
Totals		24+ guilds (46+ species)	71 guilds (100 species)	39 guilds (54 species)	58 guilds (78 species)

[a]See Table 38 for a list of species in each identified primary consumer guild.

[b]See Table 39 for a list of species in each identified secondary consumer guild.

[c]Additional guilds of secondary consumers will be adversely affected because of changes in their food chains due to the reduced biomass of primary consumers.

Ponderosa Pine-Mixed Conifer Habitat

Associations of ponderosa pine, douglas fir (Pseudotsuga menziesi), white fir (Abies concolor), and aspen (Populus tremuloides), occur in the higher elevations (above 7,500 ft; Jones 1981) and in mesic situations on north-facing slopes of the Hualapai Mountains. One hundred and forty-four vertebrate species (Appendix II) utilize this habitat as feeding and/or breeding substrate. The faunal community in this habitat type is very similar to that of the contiguous ponderosa pine type; both habitat types provide subsurface, surface, midstory, tree bole, and tree canopy layers. The wildlife species that inhabit ponderosa pine-mixed conifer habitats are arrayed into 37 guilds of primary consumers (Table 41) and 60 guilds of secondary consumers (Table 42).

Severe reduction of surface vegetation will deleteriously impact eight guilds of primary consumers (Table 43) and 12 guilds of secondary consumers. In addition, 23 guilds of primary consumers (Table 43) will be adversely affected by the limited amount of surface vegetation. Additional guilds of secondary consumers will also be adversely affected if the limited amount of surface vegetation reduces the biomass of primary consumers, thereby impacting the food chains of secondary consumers.

Extensive reduction of the midstory canopy in ponderosa pine-mixed conifer habitats will deleteriously impact the same three species (black-headed grosbeak, blue grosbeak, and hermit thrush), comprising two guilds of primary consumers and two guilds of secondary consumers, as in ponderosa pine habitats.

In addition, 27 guilds of primary consumers and 40 guilds of secondary consumers will be adversely affected (Table 43).

Reduction in the number of snags or trees with large boles will deleteriously impact five guilds of primary consumers and five guilds of secondary consumers. Ten guilds of primary consumers and 28 guilds of secondary consumers will be adversely affected (Table 43).

Extensive removal of the tree canopy will deleteriously impact one primary consumer guild and four guilds of secondary consumers. Twenty-five guilds of primary consumers and 31 guilds of secondary consumers will be adversely affected.

Ponderosa pine-mixed conifer forests need to be periodically thinned to increase the production of midstory and understory plants for wildlife. Regeneration efforts that scatter small clearcuts throughout the forest provide different seral stages of forest succession, while maintaining large blocks of forest in a mature tree stage. These conditions maximize species richness within a unit of ponderosa pine-mixed conifer forest.

Table 41. Wildlife guilds of primary consumers in ponderosa pine-mixed conifer habitats in westcentral Arizona. The interpretation of the table is as in Table 5.

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
1	BLACK BEAR				4	5	6	7	8							5	6				
2	PORCUPINE				4	5	6		8							5	6				
3	COYOTE				4	5	6									5	6				
4	STRIPED SKUNK				4	5										5	6				
	HOG-NOSED SKUNK				4	5										5	6				
	MEXICAN VOLE				4	5										5	6				
5	BOTTA'S POCKET GOPHER				4	5										5					
6	COMMON FLICKER					5	6	7	8							5			8		
7	BROAD-TAILED HUMMINGBIRD					5	6	7	8								6	7		9	
8	ACORN WOODPECKER					5	6	7	8										8		
9	YELLOW-RUMPED WARBLER					5	6	7	8												10
	RUFOUS HUMMINGBIRD					5	6	7	8												10
	ANNA'S HUMMINGBIRD					5	6	7	8												10
	CALLIOPE HUMMINGBIRD					5	6	7	8												10
10	RACCOON					5	6		8							5	6	7	8		
11	LESSER GOLDFINCH					5	6		8								6	7		9	
12	ROCK SQUIRREL					5	6		8								6				
13	CASSIN'S KINGBIRD					5	6		8									7	8	9	
14	PINON JAY					5	6		8									7		9	
	STELLER'S JAY					5	6		8									7		9	
	SCRUB JAY					5	6		8									7		9	
	BUSHTIT					5	6		8									7		9	
15	BLACK-HEADED GROSBEAK					5	6		8									7			
16	WESTERN BLUEBIRD					5	6		8										8		
17	ABERT'S SQUIRREL					5	6		8											9	
	BAND-TAILED PIGEON					5	6		8											9	

Table 41. (continued).

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
18	LEWIS' WOODPECKER					5	6		8												10
	RUBY-CROWNED KINGLET					5	6		8												10
	CLARK'S NUTCRACKER					5	6		8												10
	PINE SISKIN					5	6		8												10
	AMERICAN ROBIN					5	6		8												10
	TOWNSEND'S SOLITAIRE					5	6		8												10
	MOUNTAIN BLUEBIRD					5	6		8												10
19	BRUSH MOUSE					5	6									5	6				
	MEXICAN WOODRAT					5	6									5	6				
	STEPHENS' WOODRAT					5	6									5	6				
20	HOUSE FINCH					5	6										6	7	8	9	
21	MULE DEER					5	6										6				
	CATTLE					5	6										6				
	ELK					5	6										6				
22	BLUE GROSBEAK					5	6											7			
	HERMIT THRUSH					5	6											7			
23	SWAINSON'S THRUSH					5	6														10
	GREEN-TAILED TOWHEE					5	6														10
24	CASSIN'S FINCH					5			8												10
	PURPLE FINCH					5			8												10
25	CLIFF CHIPMUNK					5										5	6		8		
26	MOURNING DOVE					5											6	7		9	
27	COMMON RAVEN					5											6		8	9	
28	HOUSE MOUSE					5											6				
	ROCK DOVE					5											6				
	DESERT COTTONTAIL					5											6				
	RUFOUS-SIDED TOWHEE					5											6				
	EASTERN COTTONTAIL					5											6				
29	CHIPPING SPARROW					5												7		9	
30	DARK-EYED JUNCO					5															10
	WHITE-CROWNED SPARROW					5															10
	TREE SWALLOW					5															10
31	YELLOW-BELLIED SAPSUCKER						6	7	8										8		

Table 41. (concluded).

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
32	CEDAR WAXWING						6	7	8												10
33	SAY'S PHOEBE						6		8							5	6				
34	WARBLING VIREO						6		8									7		9	
35	PYGMY NUTHATCH						6		8										8		
	DOWNY WOODPECKER						6		8										8		
	HAIRY WOODPECKER						6		8										8		
	WHITE-BREASTED NUTHATCH						6		8										8		
36	HERMIT WARBLER						6		8												10
	WESTERN TANAGER						6		8												10
	RED-BREASTED NUTHATCH						6		8												10
37	WILLIAMSON'S SAPSUCKER							7													10

Table 42. Wildlife guilds of secondary consumers in ponderosa pine-mixed conifer habitats in westcentral Arizona. The interpretation of the table is as in Table 5.

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
1	COYOTE				4	5	6									5	6				
2	HOG-NOSED SKUNK				4	5										5	6				
	STRIPED SKUNK				4	5										5	6				
	BLACK BEAR				4	5										5	6				
	GILBERT'S SKINK				4	5										5	6				
3	TIGER SALAMANDER				4	5															10
4	GREAT HORNED OWL					5	6	7	8	9						5	6		8	9	
5	COMMON FLICKER					5	6	7	8	9						5			8		
6	BROAD-TAILED HUMMINGBIRD					5	6	7	8	9							6	7		9	
7	AMERICAN KESTREL					5	6	7	8	9							6		8		
	SPOTTED OWL					5	6	7	8	9							6		8		
8	WHIP-POOR-WILL					5	6	7	8	9							6				
9	WARBLING VIREO					5	6	7	8	9								7		9	
	COOPER'S HAWK					5	6	7	8	9								7		9	
10	FLAMMULATED OWL					5	6	7	8	9									8		
	ACORN WOODPECKER					5	6	7	8	9									8		
	PYGMY NUTHATCH					5	6	7	8	9									8		
	WHITE-BREASTED NUTHATCH					5	6	7	8	9									8		
11	ANNA'S HUMMINGBIRD					5	6	7	8	9											10
	CALLIOPE HUMMINGBIRD					5	6	7	8	9											10
	LEWIS' WOODPECKER					5	6	7	8	9											10
	GOLDEN-CROWNED KINGLET					5	6	7	8	9											10
	YELLOW-RUMPED WARBLER					5	6	7	8	9											10
	CLARK'S NUTCRACKER					5	6	7	8	9											10
	RUBY-CROWNED KINGLET					5	6	7	8	9											10
	RUFOUS HUMMINGBIRD					5	6	7	8	9											10
12	COMMON RAVEN					5	6	7	8								6		8	9	
13	BEWICK'S WREN					5	6	7	8								6		8		
	HOUSE WREN					5	6	7	8								6		8		
14	STELLER'S JAY					5	6	7	8									7		9	
	SCRUB JAY					5	6	7	8									7		9	

Table 42. (continued).

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
15	PYGMY OWL					5	6	7	8										8		
	SAW-WHET OWL					5	6	7	8										8		
16	ZONE-TAILED HAWK					5	6	7	8											9	
	SHARP-SHINNED HAWK					5	6	7	8											9	
17	BLACK-THROATED WARBLER					5	6	7	8												10
	ORANGE-CROWNED WARBLER					5	6	7	8												10
18	ROCK WREN					5	6	7								5	6				
19	GOSHAWK					5	6	7												9	
20	PALLID BAT					5	6		8	9						5	6		8		
21	FRINGED MYOTIS					5	6		8	9						5	6				
22	RED-FACED WARBLER					5	6		8	9							6				
23	RED BAT					5	6		8	9									8		
24	HAMMOND'S FLYCATCHER					5	6		8	9											10
	WILLOW FLYCATCHER					5	6		8	9											10
	BLUE-GRAY GNATCATCHER					5	6		8	9											10
	LEAST FLYCATCHER					5	6		8	9											10
	WESTERN FLYCATCHER					5	6		8	9											10
	DUSKY FLYCATCHER					5	6		8	9											10
	GRAY FLYCATCHER					5	6		8	9											10
25	RACCOON					5	6		8							5	6	7	8		
26	BLACK-HEADED GROSBEAK					5	6		8									7			
	BLUE GROSBEAK					5	6		8									7			
27	PAINTED REDSTART					5	6			9							6				
	VIRGINIA'S WARBLER					5	6			9							6				
28	PINON JAY					5	6			9								7		9	
29	WESTERN BLUEBIRD					5	6			9									8		
30	MOUNTAIN BLUEBIRD					5	6			9											10
	TOWNSEND'S SOLITAIRE					5	6			9											10
	WILSON'S WARBLER					5	6			9											10
	SWAINSON'S THRUSH					5	6			9											10

Table 42. (continued).

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
31	BOBCAT					5	6									5	6				
	MOUNTAIN LION					5	6									5	6				
32	SOUTHERN PLATEAU LIZARD					5	6										6				
33	HERMIT THRUSH					5	6											7			
34	MACGILLIVRAY'S WARBLER					5	6														10
	GREEN-TAILED TOWHEE					5	6														10
35	BROWN CREEPER					5		7													10
36	SAY'S PHOEBE					5				9						5	6				
	SMALL-FOOTED MYOTIS					5				9						5	6				
37	COMMON NIGHTHAWK					5				9							6				
38	CASSIN'S KINGBIRD					5				9								7	8	9	
39	WESTERN WOOD PEWEE					5				9								7		9	
40	CLIFF CHIPMUNK					5										5	6		8		
41	ARIZONA BLACK RATTLESNAKE					5										5	6				
	MOUNTAIN KING SNAKE					5										5	6				
	BRUSH MOUSE					5										5	6				
42	RED-TAILED HAWK					5											6		8	9	
43	ROCK SQUIRREL					5											6				
	RUFOUS-SIDED TOWHEE					5											6				
	CALIFORNIA WHIPTAIL					5											6				
	SHORT-HORNED LIZARD					5											6				
	TURKEY VULTURE					5											6				
	GOLDEN EAGLE					5											6				
	HOUSE MOUSE					5											6				
44	CHIPPING SPARROW					5												7		9	
45	AMERICAN ROBIN					5															10
	WHITE-CROWNED SPARROW					5															10
	SOUTHWEST TOAD					5															10
	DARK-EYED JUNCO					5															10
46	SOLITARY VIREO						6	7	8	9								7		9	

Table 42. (concluded).

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
47	DOWNY WOODPECKER						6	7	8	9									8		
	YELLOW-BELLIED SAPSUCKER						6	7	8	9									8		
	HAIRY WOODPECKER						6	7	8	9									8		
48	GRACE'S WARBLER						6	7	8	9										9	
	HEPATIC TANAGER						6	7	8	9										9	
49	HERMIT WARBLER						6	7	8	9											10
	CEDAR WAXWING						6	7	8	9											10
	WESTERN TANAGER						6	7	8	9											10
50	BUSHTIT						6	7	8									7		9	
51	TOWNSEND'S WARBLER						6	7	8												10
	WILLIAMSON'S SAPSUCKER						6	7	8												10
	RED-BREASTED NUTHATCH						6	7	8												10
52	LONG-EARED MYOTIS						6		8	9							6		8		
53	YUMA MYOTIS									9						5	6		8		
	LONG-LEGGED MYOTIS									9						5	6		8		
	BIG BROWN BAT									9						5	6		8		
	LITTLE BROWN MYOTIS									9						5	6		8		
54	SPOTTED BAT									9						5	6				
	BRAZILIAN FREE-TAILED BAT									9						5	6				
	CAVE MYOTIS									9						5	6				
	TOWNSEND'S BIG-EARED BAT									9						5	6				
	CALIFORNIA MYOTIS									9						5	6				
	WHITE-THROATED SWIFT									9						5	6				
55	PURPLE MARTIN									9						5			8		
56	ROUGH-WINGED SWALLOW									9						5					
57	CLIFF SWALLOW									9							6				
58	VIOLET-GREEN SWALLOW									9											10
	BLACK SWIFT									9											10
	BARN SWALLOW									9											10
	TREE SWALLOW									9											10
	VAUX'S SWIFT									9											10
	HOARY BAT									9											10
59	PRAIRIE FALCON										10						6				
60	LONG-EARED OWL										10									9	

Table 43. Effects of habitat alterations on primary consumer and secondary consumer guilds in ponderosa pine-mixed conifer habitats (total of 97 guilds).

Impacted guilds	Impacted system or layer of habitat				
	Aquatic	Understory	Midstory	Tree bole	Overstory
Deleterious impacts					
Primary consumers[a]		12, 21, 25-30	15, 22	8, 16, 31, 35, 37	17
Secondary consumers[b]		8, 22, 27, 32, 37, 40-45, 59	26, 33	10, 15, 23, 29, 47	16, 19, 48, 60
Totals		20 guilds (32 species)	4 guilds (3 species)	10 guilds (12 species)	5 guilds (8 species)
Adverse impacts					
Primary consumers[a]		1-11, 13-20, 22-24, 33	1-3, 6-14, 16-21, 23, 26, 29, 31-36	1, 6, 7, 9-10, 13, 20, 25, 27, 32	1-2, 6-16, 18, 20, 24, 26-27, 29, 31-36
Secondary consumers[b]		c	1, 4-25, 27-32, 34, 38-39, 44, 46-52	4-9, 11-14, 16-20, 25, 35, 38, 40, 42, 46, 48-53, 55	4-15, 17, 20-26, 28, 38-39, 42, 44, 46-47, 49-52
Totals		23+ guilds (43+ species)	67 guilds (93 species)	38 guilds (51 species)	56 guilds (73 species)

[a]See Table 41 for a list of species in each identified primary consumer guild.

[b]See Table 42 for a list of species in each identified secondary consumer guild.

[c]Additional guilds of secondary consumers will be adversely affected because of changes in their food chains due to the reduced biomass of primary consumers.

Saguaro-Palo Verde Habitat

This desertscrub habitat (Kuchler 1964, PNVT 43) occurs over about 48% of the study area (U.S. Bureau of Land Management 1980: combination of desert shrub and paloverde habitats) at elevations of 1,700-3,900 ft (Jones 1981). It provides four layers of habitat: a subsurface layer; a surface layer with rocky soils and limited herbaceous and woody cover; a midstory layer of varying height, ranging from that of creosote bushes and buckhorn cholla (Opuntia acanthocarpa) to palo verde (Cercidium microphyllum); and a tree bole layer. The saguaro (Cereus giganteus) is considered a tree without a canopy in this analysis, because of its height and the presence of a bole that is utilized by excavators and cavity users. Note the guild blocks used by wildlife in this habitat type (Fig. 14). One hundred and sixty-four vertebrate species potentially utilize breeding and/or foraging substrates in this habitat type (Appendix II). The reptilian fauna is especially rich. The wildlife community is arrayed into 28 guilds of primary consumers (Table 44) and 44 guilds of secondary consumers (Table 45).

Reduction in the already scanty surface cover and the amount of seeds and fruits on the terrestrial surface of this habitat type will deleteriously impact eight guilds of primary consumers and 11 guilds of secondary consumers (Table 46). In addition, 17 guilds of primary consumers will be adversely affected. Other guilds of secondary consumers will also be adversely affected if the limited surface vegetation reduces the biomass of primary consumers, thereby impacting the food chains of secondary consumers.

Extensive reduction in the density and diversity of the midstory layer will deleteriously impact five guilds of primary consumers and three guilds of secondary consumers. In addition, 16 guilds of primary consumers and 25 guilds of secondary consumers will be adversely affected (Table 46).

The most fragile habitat layer in this cover type is the tree bole layer, because it is susceptible to all of the natural and man-induced mortality factors that threaten saguaro cactus. Two guilds of primary consumers and four guilds of secondary consumers are dependent on cavities in the saguaro cactus as a reproductive substrate. In addition, eight guilds of primary consumers and 16 guilds of secondary consumers will be adversely affected by extensive destruction of saguaro cactus. This layer can be impacted over a wide area more easily than the other habitat layers in this vegetative cover type. The most favorable habitat management practice for wildlife in saguaro-palo verde habitat is to protect the regenerating and mature saguaro cactus and to limit grazing pressure in order to maintain the structure of the mid-story and surface vegetation.

Table 44. Wildlife guilds of primary consumers in saguaro-palo verde habitats in westcentral Arizona. The interpretation of the table is as in Table 5.

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
1	COYOTE				4	5	6									5	6				
	PORCUPINE				4	5	6									5	6				
	CACTUS MOUSE				4	5	6									5	6				
	COLLARED PECCARY				4	5	6									5	6				
2	STRIPED SKUNK				4	5										5	6				
3	BOTTA'S POCKET GOPHER				4	5										5					
4	COMMON FLICKER					5	6	7								5			8		
5	CACTUS WREN					5	6	7									6	7	8		
	HOUSE FINCH					5	6	7									6	7	8		
6	COSTA'S HUMMINGBIRD					5	6	7									6	7			
7	GILA WOODPECKER					5	6	7											8		
	LADDER-BACKED WOODPECKER					5	6	7											8		
8	BLACK-CHINNED HUMMINGBIRD					5	6	7													10
	ANNA'S HUMMINGBIRD					5	6	7													10
	SCOTT'S ORIOLE					5	6	7													10
9	WHITE-THROATED WOODRAT					5	6									5	6	7			
10	GRAY FOX					5	6									5	6				
	BIGHORN SHEEP					5	6									5	6				
	RINGTAIL					5	6									5	6				
11	STARLING					5	6									5			8		
12	ROUND-TAILED GROUND SQUIRREL					5	6									5					
	HARRIS' ANTELOPE SQUIRREL					5	6									5					
	DESERT IGUANA					5	6									5					
13	WESTERN HARVEST MOUSE					5	6										6	7	8		
14	BENDIRE'S THRASHER					5	6										6	7			
	CURVE-BILLED THRASHER					5	6										6	7			
	MOCKINGBIRD					5	6										6	7			
	BROWN-HEADED COWBIRD					5	6										6	7			

Table 44. (continued).

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
15	BURRO					5	6										6				
	CATTLE					5	6										6				
	ROCK SQUIRREL					5	6										6				
	MULE DEER					5	6										6				
16	WESTERN KINGBIRD					5	6											7	8		
17	HERMIT THRUSH					5	6														10
	LEWIS' WOODPECKER					5	6														10
	LESSER GOLDFINCH					5	6														10
	RUBY-CROWNED KINGLET					5	6														10
	SWAINSON'S THRUSH					5	6														10
	SAGE THRASHER					5	6														10
	YELLOW-RUMPED WARBLER					5	6														10
	WESTERN BLUEBIRD					5	6														10
	BUSHTIT					5	6														10
	BLACK-HEADED GROSBEAK					5	6														10
	MOUNTAIN BLUEBIRD					5	6														10
18	ARIZONA WOODRAT					5										5	6				
	WESTERN SPOTTED SKUNK					5										5	6				
	CANYON MOUSE					5										5	6				
	DESERT SPINY LIZARD					5										5	6				
19	ARIZONA POCKET MOUSE					5										5					
	DESERT TORTOISE					5										5					
	MERRIAM'S KANGAROO RAT					5										5					
	BAILEY'S POCKET MOUSE					5										5					
	KIT FOX					5										5					
	DESERT POCKET MOUSE					5										5					
	LEOPARD LIZARD					5										5					
	ROCK POCKET MOUSE					5										5					
	SOUTHERN GRASSHOPPER MOUSE					5										5					
20	MOURNING DOVE					5											6	7			
21	COMMON RAVEN					5											6		8		
22	BLACK-TAILED JACK RABBIT					5											6				
	GAMBEL'S QUAIL					5											6				
	ROCK DOVE					5											6				
	CHUCKWALLA					5											6				
	HOUSE MOUSE					5											6				
	DESERT COTTONTAIL					5											6				

Table 44. (concluded).

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
23	BLACK-THROATED SPARROW					5												7			
	BROWN TOWHEE					5												7			
24	WATER PIPIT					5															10
	DARK-EYED JUNCO					5															10
	LARK SPARROW					5															10
	SAGE SPARROW					5															10
	WHITE-CROWNED SPARROW					5															10
	BREWER'S SPARROW					5															10
	CHIPPING SPARROW					5															10
25	SAY'S PHOEBE						6									5	6				
26	VERDIN						6											7			
	PHAINOPEPLA						6											7			
27	WIED'S CRESTED FLYCATCHER						6												8		
	ASH-THROATED FLYCATCHER						6												8		
28	NORTHERN ORIOLE						6														10
	HOODED ORIOLE						6														10

Table 45. Wildlife guilds of secondary consumers in saguaro-palo verde habitats in westcentral Arizona. The interpretation of the table is as in Table 5.

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
1	RINGTAIL				4	5	6									5	6				
	COYOTE				4	5	6									5	6				
	GOPHER SNAKE				4	5	6									5	6				
2	GLOSSY SNAKE				4	5										5	6				
	WESTERN GROUND SNAKE				4	5										5	6				
	LONG-NOSED SNAKE				4	5										5	6				
	WESTERN PATCH-NOSED SNAKE				4	5										5	6				
	STRIPED SKUNK				4	5										5	6				
	COLLARED PECCARY				4	5										5	6				
3	GILA MONSTER				4	5										5					
	KIT FOX				4	5										5					
	WESTERN BLIND SNAKE				4	5										5					
	BADGER				4	5										5					
4	RING-NECK SNAKE				4	5											6				
5	GREAT HORNED OWL					5	6	7		9						5	6		8		
6	COMMON FLICKER					5	6	7		9						5			8		
	STARLING					5	6	7		9						5			8		
7	COSTA'S HUMMINGBIRD					5	6	7		9							6	7			
8	AMERICAN KESTREL					5	6	7		9							6		8		
9	LADDER-BACKED WOODPECKER					5	6	7		9									8		
	GILA WOODPECKER					5	6	7		9									8		
	ELF OWL					5	6	7		9									8		
10	SCOTT'S ORIOLE					5	6	7		9											10
	LEWIS' WOODPECKER					5	6	7		9											10
	ANNA'S HUMMINGBIRD					5	6	7		9											10
	RUBY-CROWNED KINGLET					5	6	7		9											10
	NORTHERN ORIOLE					5	6	7		9											10
	BLACK-CHINNED HUMMINGBIRD					5	6	7		9											10
	YELLOW-RUMPED WARBLER					5	6	7		9											10
	HOODED ORIOLE					5	6	7		9											10

Table 45. (continued).

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
11	CANYON WREN					5	6	7								5	6				
	ROCK WREN					5	6	7								5	6				
12	CACTUS WREN					5	6	7									6	7	8		
13	COMMON RAVEN					5	6	7									6		8		
14	ZONE-TAILED HAWK					5	6	7													10
	SHARP-SHINNED HAWK					5	6	7													10
	COOPER'S HAWK					5	6	7													10
	BEWICK'S WREN					5	6	7													10
15	CALIFORNIA LEAF-NOSED BAT					5	6			9						5	6				
	PALLID BAT					5	6			9						5	6				
16	BLACK-TAILED GNATCATCHER					5	6			9							6	7			
17	LOGGERHEAD SHRIKE					5	6			9								7			
18	LUCY'S WARBLER					5	6			9									8		
	WIED'S CRESTED FLYCATCHER					5	6			9									8		
	ASH-THROATED FLYCATCHER					5	6			9									8		
19	HAMMOND'S FLYCATCHER					5	6			9											10
	WESTERN FLYCATCHER					5	6			9											10
	DUSKY FLYCATCHER					5	6			9											10
	BLUE-GRAY GNATCATCHER					5	6			9											10
	WESTERN BLUEBIRD					5	6			9											10
	MOUNTAIN BLUEBIRD					5	6			9											10
	LEAST FLYCATCHER					5	6			9											10
	WILLOW FLYCATCHER					5	6			9											10
	GRAY FLYCATCHER					5	6			9											10
	WILSON'S WARBLER					5	6			9											10
	SWAINSON'S THRUSH					5	6			9											10
20	BOBCAT					5	6									5	6				
	DESERT SPINY LIZARD					5	6									5	6				
	ROSY BOA					5	6									5	6				
	MOUNTAIN LION					5	6									5	6				
	COACHWHIP					5	6									5	6				
	BANDED GECKO					5	6									5	6				
	CALIFORNIA KING SNAKE					5	6									5	6				
21	WESTERN HARVEST MOUSE					5	6										6	7	8		

Table 45. (continued).

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
22	BROWN-HEADED COWBIRD					5	6										6	7			
	BENDIRE'S THRASHER					5	6										6	7			
	CURVE-BILLED THRASHER					5	6										6	7			
	MOCKINGBIRD					5	6										6	7			
23	LONG-TAIL BRUSH LIZARD					5	6										6				
24	SCREECH OWL					5	6												8		
25	SAGE THRASHER					5	6														10
	BLACK-HEADED GROSBEAK					5	6														10
	HERMIT THRUSH					5	6														10
	MACGILLIVRAY'S WARBLER					5	6														10
26	SAY'S PHOEBE					5				9						5	6				
27	LESSER NIGHTHAWK					5				9							6				
	POOR-WILL					5				9							6				
28	WESTERN KINGBIRD					5				9								7	8		
29	LYRE SNAKE					5										5	6				
	NIGHT SNAKE					5										5	6				
	SIDE-BLOTCHED LIZARD					5										5	6				
	ZEBRA-TAILED LIZARD					5										5	6				
	WESTERN SPOTTED SKUNK					5										5	6				
	WESTERN DIAMONDBACK RATTLESNAKE					5										5	6				
	MOHAVE RATTLESNAKE					5										5	6				
	GRAY FOX					5										5	6				
	CANYON MOUSE					5										5	6				
	GREATER EARLESS LIZARD					5										5	6				
	SPECKLED RATTLESNAKE					5										5	6				
	COLLARED LIZARD					5										5	6				
	BLACK-TAILED RATTLESNAKE					5										5	6				
	BARN OWL					5										5	6				
	CACTUS MOUSE					5										5	6				
30	LEOPARD LIZARD					5										5					
	ROUND-TAILED GROUND SQUIRREL					5										5					
	HARRIS' ANTELOPE SQUIRREL					5										5					
	DESERT IGUANA					5										5					
	MERRIAM'S KANGAROO RAT					5										5					
	SOUTHERN GRASSHOPPER MOUSE					5										5					

Table 45. (continued).

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
31	ROADRUNNER					5											6	7			
32	RED-TAILED HAWK					5											6		8		
33	HOUSE MOUSE					5											6				
	GOLDEN EAGLE					5											6				
	SPOTTED LEAF-NOSE SNAKE					5											6				
	DESERT NIGHT LIZARD					5											6				
	PRAIRIE FALCON					5											6				
	GAMBEL'S QUAIL					5											6				
	TURKEY VULTURE					5											6				
	ROCK SQUIRREL					5											6				
	CALIFORNIA WHIPTAIL					5											6				
	DESERT HORNED LIZARD					5											6				
	REGAL HORNED LIZARD					5											6				
34	BROWN TOWHEE					5												7			
	BLACK-THROATED SPARROW					5												7			
35	LONG-EARED OWL					5													8		
36	CHECKERED GARTER SNAKE					5															10
	SAGE SPARROW					5															10
	BREWER'S SPARROW					5															10
	LARK SPARROW					5															10
	BALD EAGLE					5															10
	RED-SPOTTED TOAD					5															10
	BLACK-NECKED GARTER SNAKE					5															10
	CHIPPING SPARROW					5															10
	WHITE-CROWNED SPARROW					5															10
	DARK-EYED JUNCO					5															10
	COLORADO RIVER TOAD					5															10
	WATER PIPIT					5															10
37	WESTERN TANAGER						6	7		9											10
38	VERDIN						6	7										7			
	PHAINOPEPLA						6	7										7			
39	TOWNSEND'S WARBLER						6	7													10
	BUSHTIT						6	7													10

Table 45. (concluded).

GUILD NO.	GUILD MEMBERS	FEEDING LOCI										BREEDING LOCI									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
40	BIG BROWN BAT									9						5	6		8		
41	WHITE-THROATED SWIFT									9						5	6				
	CAVE MYOTIS									9						5	6				
	WESTERN PIPISTRELLE									9						5	6				
	CALIFORNIA MYOTIS									9						5	6				
	TOWNSEND'S BIG-EARED BAT									9						5	6				
	BRAZILIAN FREE-TAILED BAT									9						5	6				
42	ROUGH-WINGED SWALLOW									9						5					
43	CLIFF SWALLOW									9							6				
44	VIOLET-GREEN SWALLOW									9											10
	BARN SWALLOW									9											10
	VAUX'S SWIFT									9											10
	TREE SWALLOW									9											10
	BLACK SWIFT									9											10

Table 46. Effects of habitat alterations on primary consumer and secondary consumer guilds in saguaro-palo verde habitats (total of 72 guilds).

Impacted guilds	Impacted system or layer of habitat				
	Aquatic	Understory	Midstory	Tree bole	Overstory
Deleterious impacts					
Primary consumers[a]		15, 18-24	23, 25-28	7, 27	
Secondary consumers[b]		4, 23, 27, 29-36	17, 34, 38	9, 18, 24, 35	
Totals		19 guilds (70 species)	8 guilds (10 species)	6 guilds (8 species)	
Adverse impacts					
Primary consumers[a]		1-14, 16-17, 25	1, 4-17, 20	4-6, 8, 11, 13, 16, 21	
Secondary consumers[b]		c	1, 5-16, 18-25, 28, 31, 37, 39	5-8, 10-14, 21, 28, 32, 37-40	
Totals		17+ guilds (41+ species)	41 guilds (82 species)	24 guilds (31 species)	

[a]See Table 44 for a list of species in each identified primary consumer guild.

[b]See Table 45 for a list of species in each identified secondary consumer guild.

[c]Additional guilds of secondary consumers will be adversely affected because of changes in their food chains due to the reduced biomass of primary consumers.

PREDICTING HABITAT QUALITY

Wildlife guilds are groups of species whose niche hyperspace is located within the same group of guild blocks. The greater the number of habitat layers present in a cover type, the greater the number of guild blocks present. The increase in wildlife guilds occurs because the greater number of guild blocks provides more ways in which wildlife species can use the resources of habitats. The number of guilds of primary consumers and secondary consumers and the total number of wildlife guilds (determined from data in Tables 5-6, 8-9, 11-12, 14-15, 17-18, 20-21, 23-24, 26-27, 29-30, 32-33, 35-36, 38-39, 41-42, and 44-45) are highly significantly related to the number of habitat layers present in the 13 terrestrial cover types identified in the Hualapai-Aquarius planning units (Fig. 17). The presence or absence of layers of habitat thus seems to be a variable that can be used to assess the quality of habitat because the layers of habitat present determine the potential presence of guilds and their associated wildlife species.

The determination of the presence or absence of layers of habitat within a planning unit could be done with carefully interpreted aerial photography, as suggested by Short (1982). The areas of layers of habitat containing understory vegetation, midstory vegetation, a tree bole layer suitable for excavators and cavity users, and an overstory layer are added together. The sum becomes the numerator of a proportion, whose denominator is the area of the planning unit x the number of habitat layers that would be present if mature (climax) vegetation occurred throughout the planning unit. The proportion is a comparison of the present habitat condition to a standard and can be

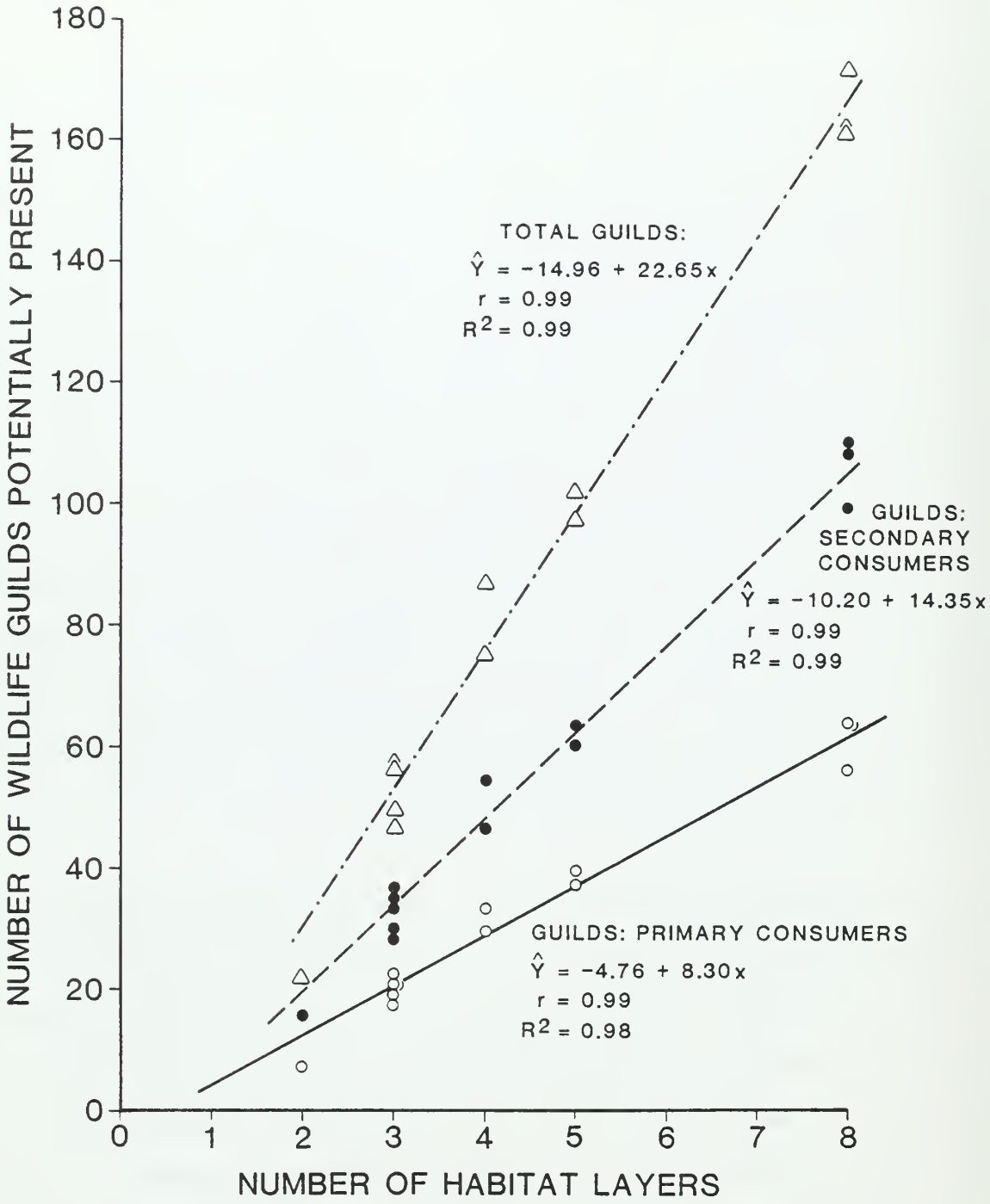


Figure 17. Relationship of wildlife guilds to habitat layers in 13 terrestrial habitats.

considered both a statement of habitat quality and a general Habitat Suitability Index (HSI) value, which can be quickly determined and used in the Habitat Evaluation Procedures (U.S. Fish and Wildlife Service (HEP 1980) accounting. The utility of the concept of estimating the area of layers of habitat present and using the estimate as an indicator of habitat quality is that a quick assessment of habitat value can be provided to planners early in the land-use planning process.

Numbers of guilds and numbers of wildlife species present are expected to increase with an increased number of layers of habitat between different habitat sites. This relationship is evident from the examination of field data obtained in 1978-79 from the Hualapai-Aquarius planning units and compiled by Hall (1980). Hall's data included measurements of the structure of vegetative cover and an extensive survey of the avifauna present during spring on 19 transects in 12 cover types. Comparable data from mammalian and herpetological surveys were not available from these vegetative transects. The number of bird species observed in each of the 19 transects during spring was determined using the Emlen belt transect procedure (Hall 1980). The 19 transects are identified in Table 1 in Hall (1980) and in Table 47 in this paper. Plant communities within the 19 transects were sampled using the line-transect toe-point method. Vegetation transects corresponded to the 1-mile strip transect used for bird sampling. Toe-point hits were recorded approximately every four paces until at least 50 plant hits were tallied. Plant hits were recorded in six height classes (Hall 1980: Table 1) but have been clumped into three height classes for this analysis: F 2 ft (0.5 m); 2-15 ft (about 0.5-5 m); and J 15 ft (/ 5 m). The equitability of vegetative cover was calculated using

Table 47. Habitat values for 19 transects in westcentral Arizona and the number of bird species and guilds found on those transects during springtime.

Vegetative cover on transect	No. of guild blocks	Percent cover	Equit-ability of cover	Guild blocks x log (cover x equit.)	No. sp. birds at transects	No. guilds with birds at transects
Cottonwood-willow (A)	36	43.6[a]	0.842[b]	56.33	31[a]	35[d]
Pinyon-juniper (B)	9	42.3	0.676	13.11	15	22
Closed chaparral (C)	9	59.9	0.258	10.70	9	9
Joshua tree-juniper (D)	9	23.8	0.687	10.92	19	21
Creosote-white bursage (E)	9	16.9	0.693	9.62	8	8
Juniper-mixed shrub (F)	9	36.7	0.607	12.13	20	19
Desert grassland (G)	4	31.8	0.584	5.08	14	6
Mesquite-bosque (H)	36	40.3	0.441	44.99	26	34
Saguaro-palo verde (I)	16	16.0	0.541	15.00	20	29
Joshua tree-creosote (J)	9	33.1	0.676	12.15	17	19
Joshua tree-creosote (K)	9	37.9	0.654	12.55	16	19
Pinyon-juniper (L)	16	42.4	0.311	17.92	15	19
Desert grassland (M)	4	14.3	0.199[c]	1.82	6	5
Desert grassland (N)	4	19.5	0.553	4.13	6	4
Open chaparral (P)	9	21.1	0.648	10.22	16	16
Juniper-mixed shrub (Q)	9	40.2	0.607	12.49	19	15
Oak-pine (S)	25	66.2	0.452	36.90	28	30
Joshua tree-creosote (T)	9	27.6	0.595	10.94	14	16
Ponderosa pine-gambel oak (U)	25	34.4	0.817	36.22	29	29

[a]Values listed in description of individual transects in Hall (1980).

[b]Calculated from values in Table 1 of Hall (1980).

[c]For ease of calculation (so multiplication by 0 will not occur), 95% of cover is assumed as understory and 5% of cover is assumed above 0.5 m.

[d]Birds on each transect were compared to lists of species comprising guilds (Tables 5-46) to determine the number of guilds containing birds occurring on each transect.

the percent vegetative cover in Hall's Table 1, clumped into the three height classes listed above, using the Shannon equation (Shannon and Weaver 1963). These values are listed under "Equitability of cover" in Table 47. Percent cover data in Table 47 are Hall's measurements, listed in his assessment of habitat conditions for each of the 19 transects.

I have, in Table 47, estimated the number of guild blocks available for the avian community in each of the 19 habitat sites. I assumed that a subsurface layer, providing breeding substrates, and a terrestrial surface layer, providing vegetative cover for breeding and feeding, were present at each site. The midstory layer was considered present at all sites except the grassland sites, although some vegetative cover apparently extends to 2 m in grassland transects G and N (Hall 1980: Table 1). The tree bole was assumed present as a habitat layer in transects A (cottonwood-willow riparian), H (mesquite-bosque), I (saguaro-palo verde), L (pinyon-juniper), S (oak-pine riparian), and U (ponderosa pine-gambel oak), because these transects had at least 5% of their total cover above 15 ft (Hall 1980: Table 1). No measurements of tree diameters at breast height were given, so it is possible that tree boles of sufficient diameter for excavators or cavity users may not comprise a habitat layer in all of these transects.

The number of habitat layers actually present in the riparian habitats is also open to interpretation. It seems likely that only five layers occur in the oak-pine riparian transect (S), which is considered riparian because of a high water table rather than the presence of free water. Transect H, mesquite-bosque, lies within the floodplain of the Big Sandy River north of Wickieup.

The Big Sandy is considered perennial south of Wickieup (Kepner 1979) and is generally described as a broad, shallow, sandy run with no riffles or pools. Kepner (1979) lists a mean depth for the Big Sandy of 4.5 inches, with a range of 1.25-10 inches. Clearly, the Big Sandy only provides an aquatic surface layer as habitat, therefore, the mesquite-bosque most likely provides six layers as wildlife habitat. The cottonwood-willow riparian community (transect A) occurs adjacent to Burro Creek. Kepner (1979) describes Burro Creek as a heterogeneous system with abundant riffle, run, and pool habitats. During the drier months, Burro Creek is reduced to intermittent pools, which can be quite deep. I have assumed, because of the intermittent flow of Burro Creek, that this system alos presents only an aquatic surface layer as habitat at least for the avian community. Therefore, the cottonwood-willow community is assumed to provide six layers of habitat for birds during the spring breeding season.

The calculation of guild blocks x log (cover x equitability of cover) is one way to interpret the effects on the avian community of variations in cover values among habitat sites with the same number of layers of habitat. The list of observed birds in each transect was compared with the list of guilds and their associated species in the corresponding vegetative cover type (Tables 5-6, 8-9, 11-12, 14-15, 17-18, 20-21, 23-24, 26-27, 29-30, 32-33, 35-36, 38-39, 41-42, and 44-45) to determine the number of bird guilds present.

The number of guild blocks present on the transects was predictive of the number of guilds of birds present during springtime (Fig. 18a). It was also predictive (although with reduced efficiency) of the number of bird species present (Fig. 18b). The lower predictability associated with numbers of

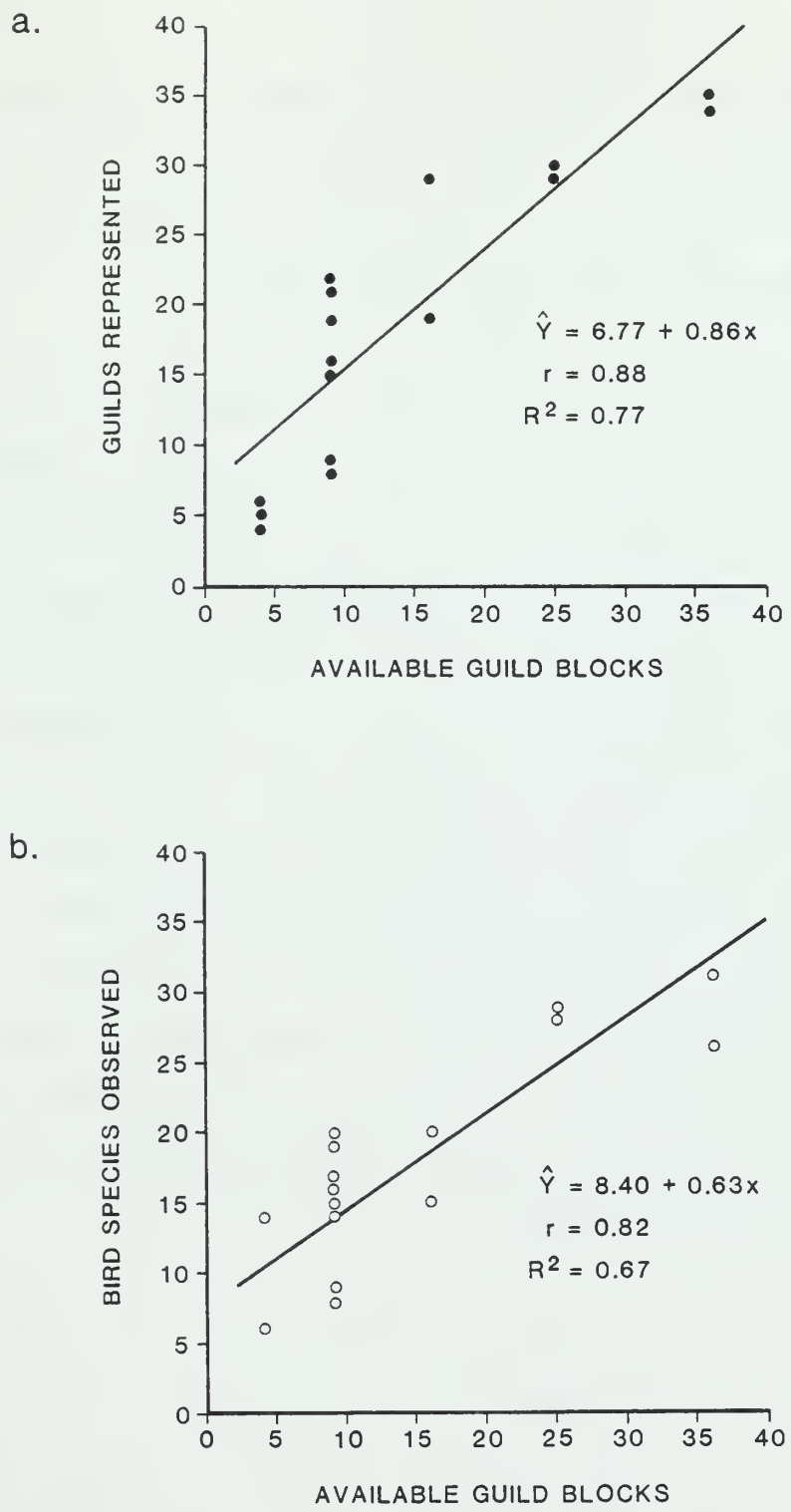


Figure 18. Relationship of the number of bird species and guilds with birds to the number of guild blocks in 19 experimental transects.

species presumably occurs because species richness can vary between habitat with a similar number of guild blocks if the cover characteristics vary between habitats. This variation in cover may provide differences in the way the resources of habitats can be partitioned among species.

The product of guild blocks x log (cover x equitability) can be used to weigh the total cover and the distribution of cover between transects with the same number of habitat layers. This model also predicted the number of bird guilds on habitat transects during spring (Fig. 19a). The model is a somewhat better predictor of the number of bird species present (Fig. 19b) than is the simpler listing of guild blocks (Fig. 18b). These data suggest that the structure of vegetation (presence of guild blocks) is significantly related to the presence of wildlife guilds on an area and that the total quantity of vegetation and the distribution of that vegetation between layers is important to the determination of the degree of packing of guild blocks with birds (numbers of species present). The two predictive models, number of guild blocks present and guild blocks x log (cover x equitability) seem to be useful predictors of the avifauna and presumably of the total wildlife community that occurs in a vegetative cover type.

The assessment of the number of guild blocks can apparently be accomplished with carefully interpreted aerial photography to give an inexpensive measure of habitat quality. This technique could be an important tool in the land-use planning process, especially during early planning activities, because it relates the presence of wildlife species to the presence of habitat layers, which represent the structure of the vegetative community. Layers of habitat

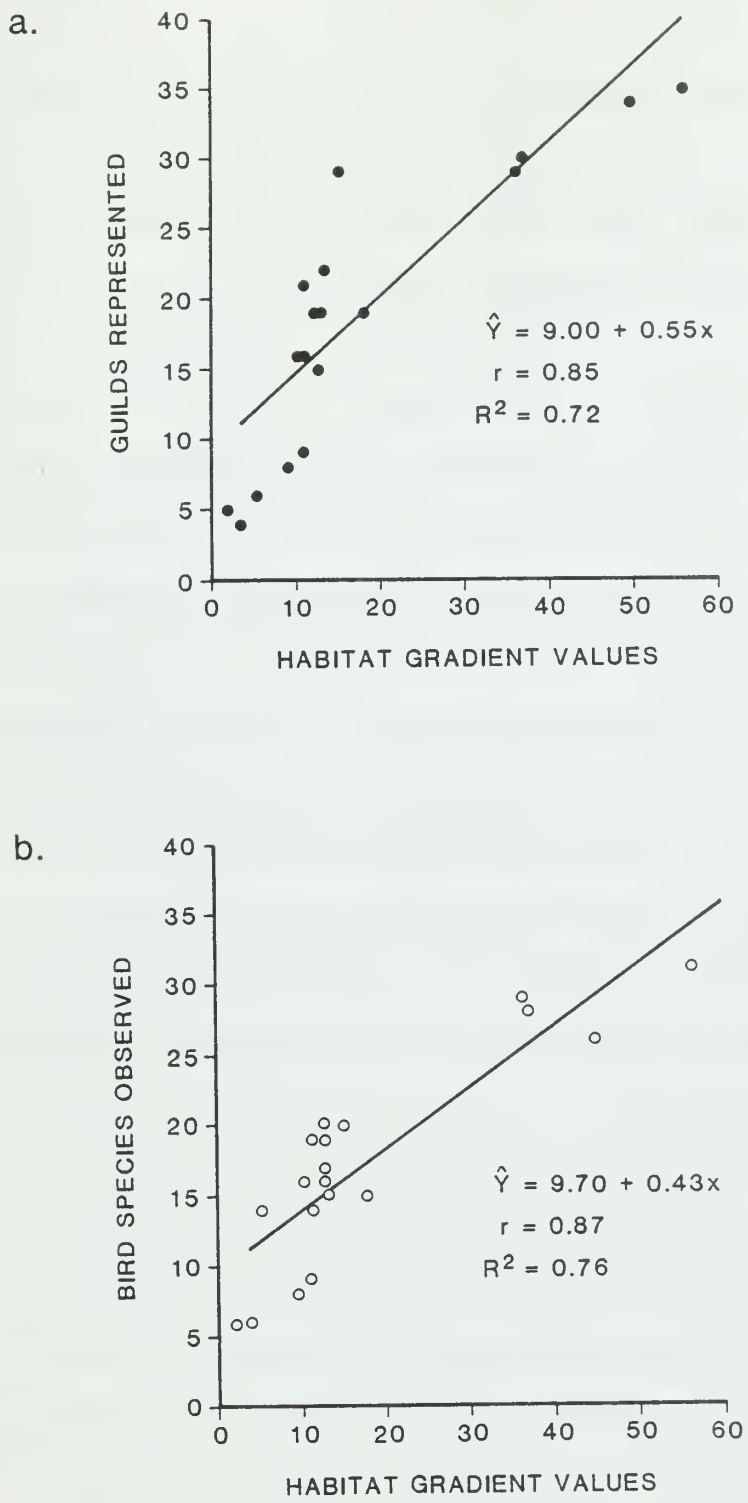


Figure 19. Relationship of the number of bird species and guilds with birds to measures of a habitat gradient in 19 experimental transects.

represent a common denominator in natural resource management because land-use changes can frequently be interpreted as alterations to habitat layers, and changes in habitat layers have a predictive relationship with the presence of wildlife guilds and the total wildlife community.

PREDICTING NUMBERS OF GUILDS AND SPECIES OF BIRDS FROM THE GUILD MODEL

The application of guild blocks to predict the number of guilds with birds in a cover type and the habitat gradient model to predict the number of breeding bird species on an area was tested with a series of habitat transects in the Lower Gila North (LGN) planning units. These planning units are south of the Bill Williams River, pictured in Figure 10. This is a test to determine if the predictive relationships developed in the Hualapai-Aquarius (HA) planning units would also be applicable in the LGN. The two areas are both in ecoregion 3222. The same layers of habitat were present in common cover types in both the HA and LGN areas.

Data about vegetative cover, similar to that collected for habitat transects in the HA and reported in Table 47, were analyzed for 14 habitat transects in the LGN. These habitat data and the habitat gradient values are summarized in Table 49. A census for birds was taken during springtime on each of the LGN transects, using the Emlen belt transect procedure.

The guilds containing birds that are potentially present on the LGN transects are listed in Table 48. This description is derived from the listing of guilds in Tables 5-6, 8-9, 14-15, 17-18, 23-24, 32-33, 35-36, and 44-45 that contain bird species. These tables describe the wildlife guilds for the cover types on the HA that most nearly represent the cover types containing the LGN transects. The predicted number of guilds in the LGN transects is determined with the regression equation in Figure 18a. The number of bird guilds actually present on a transect was determined by comparing the list of bird species censused on the transect with the guilds containing those species in the appropriate cover types. The prediction equation in Figure 18a predicted a number of guilds for each LGN transect that averaged about 40% of the potential number of guilds that could occur in that cover type. Thus, for transect A (Saguaro-palo verde) in the LGN, a total of 21 bird guilds was predicted as being present even though 52 guilds are potentially present in that cover type (Table 48). Likewise, for transect T (joshua tree-creosote bush) in the LGN, a total of 15 guilds was predicted present, even though 38 guilds are potentially present, etc. The actual number of guilds on the LGN transects was similar to the number of guilds predicted to be present on those transects. The correlation of predicted guilds to actual guilds on the 14 transects was $r = 0.90$, Figure 20a. Therefore, the predictive equation developed from data in the HA was also highly predictive of the number of guilds with birds present in habitat transects in the LGN.

Table 48. The number of guilds with birds potentially present on transects in the Lower Gila North Planning Units. The number of guilds actually present and the number of guilds predicted present on those transects are also included.

Lower Gila North (LGN) transect	Guild comparisons based on Hualapai-Aquarius (HA) cover type	Total guilds with birds	Predicted no. guilds on LGN transect	Actual no. guilds on LGN transect	Data from table no.	Identification of primary (P) and secondary (S) guilds potentially present on transect. Guild nos. are those listed for the appropriate cover type in the HA planning units. Guilds circled are those present in LGN transect.
Saguaro-palo verde (A)	Saguaro-palo verde	52	21	23	44	P (5), (6), 7, (8), 9, 12, (15), 17, (18), (21), 22, (23), (24), (25), 26, (27), (28), 29
					45	S 7, (8), 9, 10, (11), 12, 13, (14), 15, 16, (18), (19), (20), 21, (24), 26, (27), 28, 29, 30, 31, 33, 34, (35), (36), 37, (38), 39, (40), 41, 43, 44, 45, 46
Joshua tree-creosote bush (T)	Joshua tree-creosote bush	38	15	15	17	P (8), 9, (10), (12), 13, (16), (17), (18), 19, 20, (21), 22
					18	S 7, (8), 9, (10), (11), 12, 13, (14), 15, (16), 17, 18, 19, (20), 21, 24, (25), (26), 27, 28, 29, 30, 31, 32, 33, 34

Table 48. (continued)

Lower Gila North (LGN) transect	Guild comparisons based on Hualapai-Aquarius (HA) cover type	Total guilds with birds	Predicted no. guilds on LGN transect	Actual no. guilds on LGN transect	Data from table no.	Identification of primary (P) and secondary (S) guilds potentially present on transect. Guild nos. are those listed for the appropriate cover type in the HA planning units. Guilds circled are those present in LGN transect.
Crucifixion thorn scrub (W)	Chaparral	34	15	16	5	P (7), (9), (10), (13), (14), (15), 16, 17, 18, (19)
					6	S 2, 6, (7), 8, (9), 10, (11), 12, (13), 14, 15, 16, 17, (20), (21), (22), 23, (24), 25, (26), 27, 28, 29, 30
						2 species in LGN transect not present in HA cover type.
Crucifixion thorn scrub (N)	Chaparral	34	15	8	5	P (7), 9, 10, (13), 14, (15), 16, 17, 18, (19)
					6	S 2, 6, 7, 8, (9), 10, (11), 12, 13, 14, 15, 16, 17, 20, 21, (22), 23, 24, 25, (26), 27, 28, 29, 30
Desert Grassland (G)	Desert grassland	13	10	6	14	P (6), (7)
					15	S 4, (5), (6), (8), 9, (10), 11, 12, 13, 14, 15
						1 species in LGN transect not present in HA cover type.

Table 48. (continued)

Lower Gila North (LGN) transect	Guild comparisons based on Hualapai-Aquarius (HA) cover type	Total guilds with birds	Predicted no. guilds on LGN transect	Actual no. guilds on LGN transect	Data from table no.	Identification of primary (P) and secondary (S) guilds potentially present on transect. Guild nos. are those listed for the appropriate cover type in the HA planning units. Guilds circled are those present in LGN transect.
Open chaparral (I)	Chaparral	34	15	19	5	P (7), (9), (10), (13), (14), (15), (16), 17, 18, (19)
					6	S (2), 6, (7), 8, (9), (10), (11), 12, (13), (14), 15, 16, 17, 20, (21), (22), (23), 24, 25, (26), 27, 28, 29, 30
Open chaparral (BB)	Chaparral	34	15	23	5	P (7), (9), (10), (13), (14), (15), (16), (17), 18, (19)
					6	S (2), 6, (7), 8, (9), (10), (11), 12, (13), (14), (15), 16, 17, 20, (21), (22), (23), (24), (25), (26), 27, 28, 29, 30
Closed chaparral (J)	Chaparral	34	15	12	5	P (7), (9), (10), 13, (14), (15), 16, 17, 18, 19
					6	S 2, 6, 7, 8, (9), 10, (11), 12, (13), (14), 15, 16, (17), 20, (21), (22), 23, 24, 25, 26, 27, 28, 29, 30

Table 48. (continued)

Lower Gila North (LGN) transect	Guild comparisons based on Hualapai-Aquarius (HA) cover type	Total guilds with birds	Predicted no. guilds on LGN transect	Actual no. guilds on LGN transect	Data from table no.	Identification of primary (P) and secondary (S) guilds potentially present on transect. Guild nos. are those listed for the appropriate cover type in the HA planning units. Guilds circled are those present in LGN transect.
Closed chaparral (U)	Chaparral	34	15	19	5	P (7), (9), (10), (13), (14), (15), 16, (17), 18, (19)
					6	S 2, 6, 7, 8, (9), 10, (11), 12, (13), (14), (15), 16, (17), 20, (21), (22), (23), 24, (25), (26), 27, 28, 29, 30
Juniper-pinyon (C)	Juniper-pinyon	59	21	22	23	P (5), 6, 10, 12, (13), (16), (17), 18, (19), (23), 24, (25), 26, 27, 28, 29, 30, (31), (32), 33
					24	S 2, 8, (9), 10, (11), 12, (13), 14, (16), (17), 18, 21, 22, (23), 24, (26), 28, 29, 30, 31, 32, 33, (34), 35, (36), (40), 41, (42), 43, 44, 45, 46, (47), (48), 50, 51, 52, 53, 54
						1 species in LGN transect not present in HA cover type.

Table 48. (continued)

Lower Gila North (LGN) transect	Guild comparisons based on Hualapai-Aquarius (HA) cover type	Total guilds with birds	Predicted no. guilds on LGN transect	Actual no. guilds on LGN transect	Data from table no.	Identification of primary (P) and secondary (S) guilds potentially present on transect. Guild nos. are those listed for the appropriate cover type in the HA planning units. Guilds circled are those present in LGN transect.
Juniper-pinyon (V)	Juniper-pinyon	59	21	19	23	P 5, 6, 10, 12, (13), 16, (17), (18), 19, 23, (24), (25), (26), 27, 28, (29), 30, 31, 32, 33
					24	S 2, 8, 9, 10, (11), (12), 13, 14, (16), (17), 18, 21, 22, 23, (24), (26), (28), 29, 30, 31, (32), 33, 34, 35, 36, 40, 41, (42), (43), 44, 45, (46), 47, 48, 50, 51, 52, (53), 54
Mixed riparian scrub (H)	Mixed riparian scrub	39	21	28	35	P (7), 8, (9), (11), (12), (15), (16), (17), (18), 19, (20), (21)
					36	S 2, 7, (8), 9, (10), (11), (12), 13, (14), 15, (16), (17), 18, (19), 20, 22, (24), (25), (26), (27), (28), (29), (30), 31, (32), (33), (34)
						2 species in LGN transect not present in HA cover type.

Table 48. (continued)

Lower Gila North (LGN) transect	Guild comparisons based on Hualapai-Aquarius (HA) cover type	Total guilds with birds	Predicted no. guilds on LGN transect	Actual no. guilds on LGN transect	Data from table no.	Identification of primary (P) and secondary (S) guilds potentially present on transect. Guild nos. are those listed for the appropriate cover type in the HA planning units. Guilds circled are those present in LGN transect.
Cottonwood willow riparian (D)	Cottonwood willow riparian	113	38	46	8	P 1, 2, 3, 14, 15, 16, (22), 23, 24, 25, (29), (31), (33), (34), (35), (36), (37), (41), (42), (43), (45), (46), 47, 48, (51), (52), 53, (54), 55, 56, (57), (58), (59), (60), 61, 62, 63
					9	S 2, 4, (5), 6, 7, 8, 11, 12, 13, 16, 25, 26, 27, 28, 29, 31, 32, (33), 36, 37, 38, 43, (44), 45, 46, 47, (48), (49), (50), 51, (53), 54, (55), 56, 59, 60, (61), (62), 63, (64), (65), 66, 67, 68, (69), 70, (71), 72, (74), (75), (77), 78, 79, (80), (81), (82), 83, 88, 89, 90, (91), 92, (93), 94, (95), (96), (97), 98, 100, 102, (103), 104, 105, 106, 107, 108
						1 species in LGN transect not present in HA cover type.

Table 48. (concluded)

Lower Gila North (LGN) transect	Guild comparisons based on Hualapai-Aquarius (HA) cover type	Total guilds with birds	Predicted no. guilds on LGN transect	Actual no. guilds on LGN transect	Data from table no.	Identification of primary (P) and secondary (S) guilds potentially present on transect. Guild nos. are those listed for the appropriate cover type in the HA planning units. Guilds circled are those present in LGN transect.
Mixed broadleaf riparian (AA)	Mixed broadleaf riparian	105	38	35	32	P 1, 2, 11, 12, 13, 19, 20, 21, 22, (26), (28), (29), (30), (31), 32, 33, (37), (38), (39), (41), 42, 43, (46), 47, (48), 49, 50, (51), (52), 53, (54), 55, 56
					33	S 2, 3, 4, 5, 6, 9, 10, 11, 14, 22, 23, 24, 25, 27, 28, 32, 33, 34, 39, 40, 41, 42, (43), 44, (45), (46), (48), (49), 50, 51, 52, 53, 56, 57, (58), (59), 60, 61, (62), (63), 64, 65, 66, (67), (69), (70), (72), 73, 74, (75), (76), (77), 83, 84, 85, (86), 87, (88), 89, 90, (91), 92, (93), 94, 97, (99), 100, 101, 102, 103, 104, 105
						3 species in LGN transect not present in HA cover type.

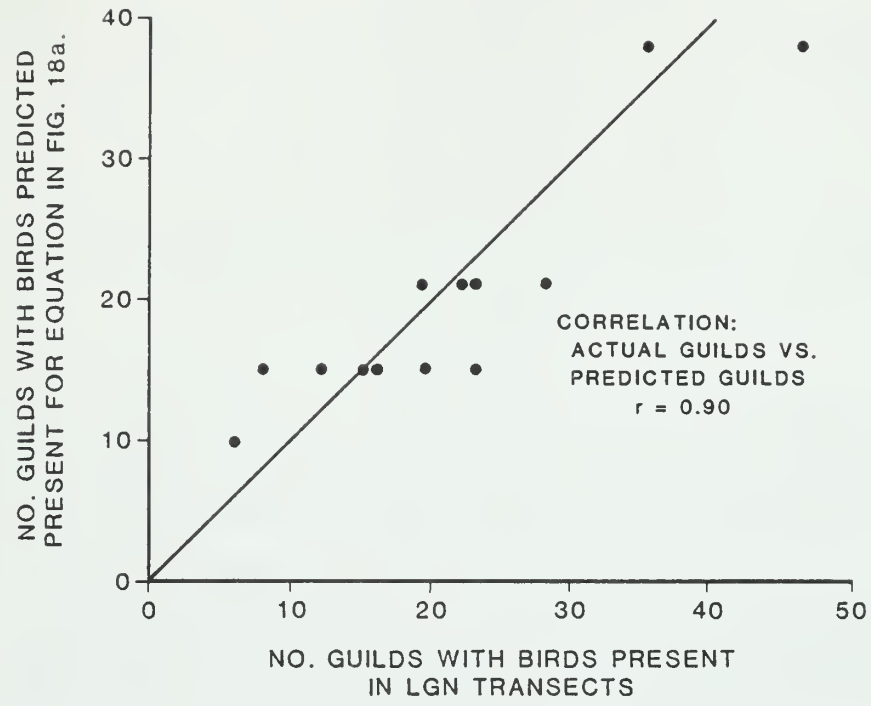
The effort expended in running a single Emlen belt transect seems sufficient to determine about 40% of the bird guilds potentially present in the transects on the LGN. Perhaps these desert habitats only provide habitat for a portion of the avifauna that can potentially occur in a cover type. It is also possible that the belt transect technique only surveys the most common and conspicuous species in a cover type and that these species provide a relatively constant proportion of the total avifauna in an area. Perhaps the effort associated with a single belt transect is insufficient to adequately determine the structure of the avian community in a cover type. The amount of effort (number of transects) that might be required to adequately describe the avian community (presence or absence of individual guilds at some stated level of probability) cannot be determined from the available data.

The habitat gradient values for the 14 transects in the LGN, as well as the predicted number of bird species, the total number of bird species, and the total number of breeding bird species on the 14 transects, are listed in Table 49. The number of breeding bird species predicted to be present on the LGN transects was determined from the prediction equation in Figure 19b. The number of bird species predicted present on the LGN transects was compared to two different types of bird populations in this analysis: breeding birds only and total birds which consisted of breeding birds and transients. The predicted number of bird species present on the LGN transects was poorly related to the number of species of breeding birds plus transients observed on the habitat transects ($r = 0.49$). Twelve of the LGN transects contained bird species that had been identified in the guild analysis as breeding outside the transect cover type. At least 50% of the bird species in three LGN transects

(open chaparral transects I and BB and mixed riparian scrub transect H in Table 49) do not nest in those transect cover types. The number of birds predicted present on the 14 transects in the LGN was highly correlatd with the number of species of breeding birds observed on those transects (Figure 20b, $r = 0.85$).

The community guild model provides a description of the potential composition of the wildlife community in a variety of cover types. The determination of the wildlife community actually present requires results from field inventories. Comparisons of the results of field inventories with predictions of the potential composition of wildlife communities can also be used to determine the adequacies or inadequacies of the field inventory procedures. For example, results from the LGN inventories suggest a single Emlen belt transect may not provide an adequate description of the avian community in a cover type. The results also suggest that inventory data will not accurately reflect the ability of vegetative communities to support bird communities if some of the bird censuses occur at a time of the year when both breeding and transient species are present.

a.



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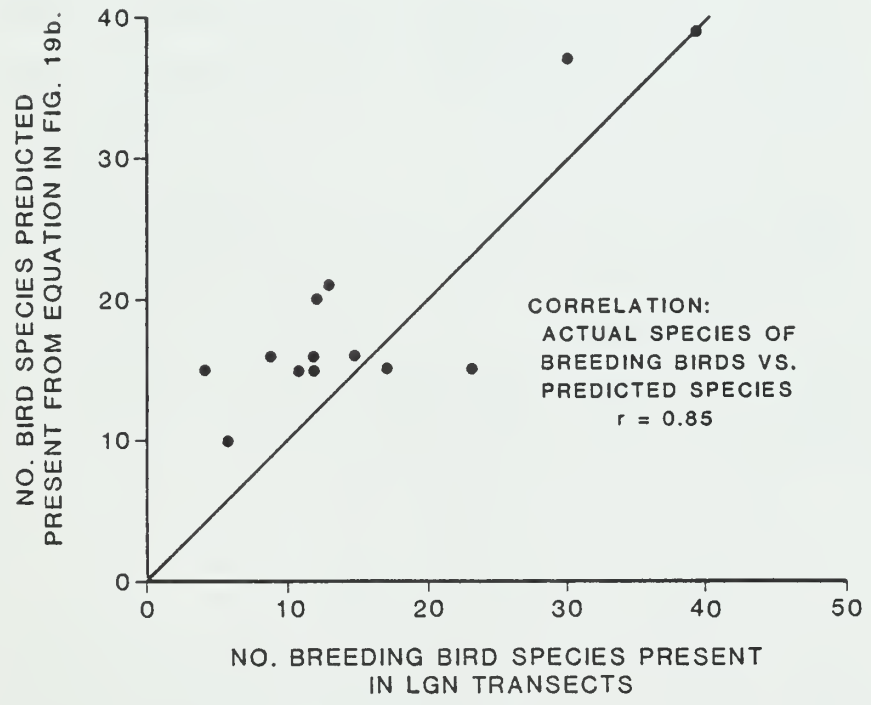

Figure 20. Relationship between predicted numbers of guilds and species of breeding birds on transects in the Lower Gila North and the actual number of guilds and species of breeding birds found on those transects.

Table 49. Habitat values for 14 transects in the Lower Gila North planning units and the predicted and actual number of total birds and of breeding birds found on those transects.

Transect in Lower Gila North	No. of guild blocks	Percent cover	Equitability of cover	Guild blocks × log (cover × equit.)	Predicted no. bird species on transects	Actual no. bird species on transects	Actual no. of breeding bird species on transects
Saguaro-palo verde (A)	16	82.7	0.451	25.1	21	15	13
Joshua tree-creosote (T)	9	47.1	0.575	12.9	15	17	17
Crucifixion thorn scrub (W)	9	56.8	0.505	13.1	15	19	11
Crucifixion thorn scrub (N)	9	39.1	0.619	12.5	15	6	4
Desert grassland (G)	4	49.4	0.056	1.8	10	8	6
Open chaparral (I)	9	62.7	0.354	12.1	15	26	12
Open chaparral (BB)	9	75.9	0.526	14.4	16	30	15
Closed chaparral (J)	9	74.3	0.605	14.9	16	12	9
Closed chaparral (U)	9	64.6	0.679	14.8	16	20	12
Juniper-pinyon (C)	16	51.7	0.652	24.4	20	16	12
Juniper-pinyon (V)	16	61.1	0.653	25.6	21	16	13
Mixed riparian scrub (H)	9	32.3	0.637	11.8	15	47	23
Cottonwood-willow riparian (D)	36	76.6	1.065	68.8	39	41	39
Mixed broad-leaf riparian (AA)	36	67.6	0.867	63.6	37	32	30

DISCUSSION

The development of guilds in the present study was somewhat different from that reported earlier by Short and Burnham (1982). They determined guilds of wildlife species by comparing the areas that the species occupied in a species-habitat matrix. Similar areas in similar portions of the matrix were clustered, using standard cluster analysis algorithms, into groups of wildlife species that apparently used the resources of a habitat in about the same way. Several assumptions were made to enhance the statistical analyses, generally dealing with how food sources and breeding substrates were ordered in the species-habitat matrix.

The wildlife guilds developed in the present analysis have evolved from the concepts in the paper by Short and Burnham (1982). Several of the assumptions and much of the statistics in the earlier paper have been vastly simplified in the present report. The concept of the species-habitat matrix is still basic to the guilding concept; the y-axis of the matrix still represents the habitat layers where foraging occurs and the x-axis still represents the habitat layers where nesting, hatching, or birthing occurs. Wildlife guilds in the present study, however, were developed as groups of species that share similar combinations of guild blocks in the species-habitat matrix, rather

than on the basis of a statistical assessment of the area occupied by a species in the species-habitat matrix, as was done in Short and Burnham (1982). The wildlife guilds in this study, therefore, are composed of groups of species that utilize the same guild blocks, either as primary consumers or as secondary consumers. Neither the order in which food sources or breeding substrates occur in a habitat layer nor even the order in which layers of habitat are arrayed in the species-habitat matrix are critical to the development of the species-habitat matrix, as was the case in the Short and Burnham (1982) study. In addition, the development of wildlife guilds is much easier and more economical because the large computer mainframe necessary for conducting the cluster analysis algorithms is not needed. Sorting species into wildlife guilds on the basis of their requirements for layers of habitat also eliminates some statistical problems inherent in the procedure of Short and Burnham (1982). For example, the determination of an Euclidean distance that consistently aggregates values for wildlife species into meaningful wildlife guilds is no longer a problem. Finally, the use of the sorting routine has the further advantage of developing wildlife guilds that share the same guild blocks with greater fidelity than did the procedure reported earlier by Short and Burnham (1982).

The positioning of the niche hyperspace of a species within one or more layers of habitat is useful to the resource manager because layers of habitat can be used as the common denominator when considering animal-habitat relationships (Short ms). Layers of habitat constitute the structural features of landscapes that are modified by land use change, are both recognizable and measurable, and are required by terrestrial wildlife species as habitat.

Trends in habitat suitablity for particular wildlife guilds and species can be determined by periodically measuring, either by on-site assessments or from interpreted aerial photographs, changes in the area of different habitat layers and in the sizes of blocks of habitat layers over time.

The impacts of any proposed land use change on the wildlife community can be determined by using the relationship between wildlife guilds and layers of habitat. Timber harvest, for example, reduces the number of guild blocks available as wildlife habitat because of the removal of the tree bole and tree canopy layers. The guilds of wildlife in an area that would be impacted by large clear cuts of timber are evident from data like that in Tables 5-46. The impact of a land use change on the wildlife community can be expressed in terms of the percent change in the areas of layers of habitats lost to the land use change. The result seems a useful measure of the magnitude of the impact on the wildlife community. The resource manager can make land use decisions that are the most desirable for the wildlife community by designing developments that impact the fewest possible layers of habitat and cause the least fragmentation of habitat blocks.

The guilding model provides a statement of the potential wildlife community that can occur in a cover type. A particular wildlife guild may be predicted to be a part of the wildlife community throughout an ecoregion. The wildlife species actually present within the guild may vary from area to area within this ecoregion. Species A may be expected to be a member of the guild when guild components are sampled within the range of species A. That species

obviously will not be a guild member when guild representatives are sampled outside the range of A.

Layers of habitat vary in quality for wildlife. Equal cover may occur in two areas but more species may occur in one area if vegetation is distributed throughout the area rather than being present in a few clumps of dense cover. The same wildlife guilds may be present in the two areas but the number of species per guild might be greater where the cover is more equally distributed. A variety of habitats within an ecoregion can frequently be arrayed along a habitat gradient developed on the basis of number of guild blocks and cover characteristics. Wildlife species can themselves be arrayed along the habitat gradient where the occurrence of each species can be described by some sort of distribution curve that indicates optimal and suboptimal habitat conditions for each species. A wildlife species within its distribution range can be considered as occurring along the habitat gradient as long as habitat conditions do not violate the species' tolerance for life requisites. Thus, a wildlife species may be a common or uncommon member of a wildlife guild within a variety of cover types within its distributional range.

The guild model describes a structure for the wildlife community that can occur in a cover type. The guild model is a planning tool in-so-far as it ties the structure of the wildlife community to layers of habitat and emphasizes that land-use change can be frequently considered in terms of impacts to layers of habitat. The guild model is complementary to field inventory assessments. Field surveys become assessments to verify whether the proposed structure of the wildlife community actually occurs on an area. The model also

provides a stratified sampling system for designing field surveys because cover types with multiple layers and many wildlife guilds need to be sampled more intensively than cover types with simpler structures. Wildlife guilds that are dependent on guild blocks that are in short supply contain species that are candidates for special management considerations.

The community guild model is applicable to aquatic systems as well as to terrestrial systems. The model when applied to aquatic systems describes guilds as groups of species that depend on aquatic layers for foraging and breeding requirements, or that depend on aquatic layers for breeding requirements and terrestrial layers for foraging, or that breed in terrestrial layers but depend on the aquatic layers for foraging. Thus, the guild model can describe in a general way how the aquatic system or the aquatic-terrestrial interface is used by the wildlife community. In addition, the layers of habitat in the aquatic system can also be considered in the same common denominator sense as are layers of habitat in terrestrial systems. The area of the water surface before and after proposed development is a useful measure of impact area just as the area of the tree canopy is a useful measure of impact area. Both measures can be related to plans of land-use change and can predict impacts upon the wildlife community because the guilding process has associated wildlife species with these layers of habitat.

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Appendix I. Common and scientific names of vertebrate species breeding and/or feeding in west-central Arizona that are treated in this analysis of wildlife guilds.

Species no.	Species common name	Species scientific name
Birds		
1	Abert's towhee	*Pipilo aberti*
2	Acorn woodpecker	*Melanerpes formicivorus*
3	American avocet	*Recurvirostra americana*
4	American bittern	*Botaurus lentiginosus*
5	American coot	*Fulica americana*
6	American goldfinch	*Carduelis tristis*
7	American kestrel	*Falco sparverius*
8	American redstart	*Setophaga ruticilla*
9	American robin	*Turdus migratorius*
10	American wigeon	*Anas americana*
11	Anna's hummingbird	*Calypte anna*
12	Ash-throated flycatcher	*Myiarchus cinerascens*
13	Baird's sandpiper	*Calidris bairdii*
14	Bald eagle	*Haliaeetus leucocephalus*
15	Band-tailed pigeon	*Columba fasciata*
16	Barn owl	*Tyto alba*
17	Barn swallow	*Hirundo rustica*
18	Bell's vireo	*Vireo bellii*
19	Belted kingfisher	*Megaceryle alcyon*
20	Bendire's thrasher	*Toxostoma bendirei*
21	Bewick's wren	*Thryomanes bewickii*
22	Black hawk	*Buteogallus anthracinus*
23	Black phoebe	*Sayornis nigricans*
24	Black swift	*Cypseloides niger*
25	Black tern	*Chlidonias niger*
26	Black-chinned hummingbird	*Archilochus alexandri*
27	Black-chinned sparrow	*Spizella atrogularis*
28	Black-crowned night heron	*Nycticorax nycticorax*
29	Black-headed grosbeak	*Pheucticus melanocephalus*
30	Black-necked stilt	*Himantopus mexicanus*
31	Black-tailed gnatcatcher	*Polioptila melanura*
32	Black-throated gray warbler	*Dendroica nigrescens*
33	Black-throated sparrow	*Amphispiza bilineata*
34	Blue grosbeak	*Guiraca caerulea*
35	Blue-gray gnatcatcher	*Polioptila caerulea*
36	Blue-winged teal	*Anas discors*
37	Bonaparte's gull	*Larus philadelphia*
38	Brewer's blackbird	*Euphagus cyanocephalus*
39	Brewer's sparrow	*Spizella breweri*
40	Bridled titmouse	*Parus wollweberi*
41	Broad-tailed hummingbird	*Selasphorus platycercus*
42	Brown creeper	*Certhia familiaris*
43	Brown towhee	*Pipilo fuscus*

Appendix I. (continued)

Species no.	Species common name	Species scientific name
44	Brown-headed cowbird	*Molothrus ater*
45	Bufflehead	*Bucephala albeola*
46	Burrowing owl	*Athene cunicularia*
47	Bushtit	*Psaltriparus minimus*
48	Cactus wren	*Campylorhynchus brunneicapillus*
49	Calliope hummingbird	*Stellula calliope*
50	Canada goose	*Branta canadensis*
51	Canvasback	*Aythya valisineria*
52	Canyon wren	*Catherpes mexicanus*
53	Cardinal	*Cardinalis cardinalis*
54	Cassin's finch	*Carpodacus cassinii*
55	Cassin's kingbird	*Tyrannus vociferans*
56	Cedar waxwing	*Bombycilla cedrorum*
57	Chestnut-collared longspur	*Calcarius ornatus*
58	Chipping sparrow	*Spizella passerina*
59	Cinnamon teal	*Anas cyanoptera*
60	Clark's nutcracker	*Nucifraga columbiana*
61	Cliff swallow	*Petrochelidon pyrrhonota*
62	Common crow	*Corvus brachyrhynchos*
63	Common flicker	*Colaptes auratus*
64	Common gallinule	*Gallinula chloropus*
65	Common goldeneye	*Bucephala clangula*
66	Common loon	*Gavia immer*
67	Common merganser	*Mergus merganser*
68	Common nighthawk	*Chordeiles minor*
69	Common raven	*Corvus corax*
70	Common snipe	*Capella gallinago*
71	Common yellowthroat	*Geothlypis trichas*
72	Cooper's hawk	*Accipiter cooperii*
73	Costa's hummingbird	*Calypte costae*
74	Crissal thrasher	*Toxostoma dorsale*
75	Curve-billed thrasher	*Toxostoma curvirostre*
76	Dark-eyed junco	*Junco hyemalis*
77	Dipper	*Cinclus mexicanus*
78	Double-crested cormorant	*Phalacrocorax auritus*
79	Downy woodpecker	*Picoides pubescens*
80	Dunlin	*Calidris alpina*
81	Dusky flycatcher	*Empidonax oberholseri*
82	Eared grebe	*Podiceps nigricollis*
83	Eastern meadowlark	*Sturnella magna*
84	Elf owl	*Micrathene whitneyi*
85	Ferruginous hawk	*Buteo regalis*
86	Flammulated owl	*Otus flammeolus*
87	Forster's tern	*Sterna forsteri*
88	Fox sparrow	*Passerella iliaca*
89	Gadwall	*Anas strepera*

Appendix I. (continued)

Species no.	Species common name	Species scientific name
90	Gambel's quail	*Lophortyx gambelii*
91	Gila woodpecker	*Melanerpes uropygialis*
92	Golden eagle	*Aquila chrysaetos*
93	Golden-crowned kinglet	*Regulus satrapa*
94	Goshawk	*Accipiter gentilis*
95	Grace's warbler	*Dendroica graciae*
96	Gray flycatcher	*Empidonax wrightii*
97	Gray vireo	*Vireo vicinior*
98	Great blue heron	*Ardea herodias*
99	Great egret	*Casmerodius albus*
100	Great horned owl	*Bubo virginianus*
101	Great-tailed grackle	*Quiscalus mexicanus*
102	Greater scaup	*Aythya marila*
103	Greater yellowlegs	*Tringa melanoleucus*
104	Green heron	*Butorides striatus*
105	Green-tailed towhee	*Pipilo chlorurus*
106	Green-winged teal	*Anas crecca*
107	Hairy woodpecker	*Picoides villosus*
108	Hammond's flycatcher	*Empidonax hammondii*
109	Hepatic tanager	*Piranga flava*
110	Hermit thrush	*Catharus guttatus*
111	Hermit warbler	*Dendroica occidentalis*
112	Hooded oriole	*Icterus cycullatus*
113	Horned grebe	*Podiceps auritus*
114	Horned lark	*Eremophila alpestris*
115	House finch	*Carpodacus mexicanus*
116	House sparrow	*Passer domesticus*
117	House wren	*Troglodytes aedon*
118	Killdeer	*Charadrius vociferus*
119	Ladder-backed woodpecker	*Picoides scalaris*
120	Lark bunting	*Calamospiza melanocorys*
121	Lark sparrow	*Chondestes grammacus*
122	Lawrence's goldfinch	*Carduelis lawrencei*
123	Lazuli bunting	*Passerina amoena*
124	Least bittern	*Ixobrychus exilis*
125	Least flycatcher	*Empidonax minimus*
126	Least sandpiper	*Calidris minutilla*
127	Lesser goldfinch	*Carduelis psaltria*
128	Lesser nighthawk	*Chordeiles acutipennis*
129	Lesser scaup	*Aythya affinis*
130	Lewis' woodpecker	*Melanerpes lewis*
131	Lincoln's sparrow	*Melospiza lincolnii*
132	Loggerhead shrike	*Lanius ludovicianus*
133	Long-billed curlew	*Numenius americanus*
134	Long-billed dowitcher	*Limnodromus scolopaceus*
135	Long-billed marsh wren	*Cistothorus palustris*

Appendix I. (continued)

Species no.	Species common name	Species scientific name
136	Long-eared owl	*Asio otus*
137	Lucy's warbler	*Vermivora luciae*
138	MacGillivray's warbler	*Oporornis tolmiei*
139	Mallard	*Anas platyrhynchos*
140	Merlin	*Falco columbarius*
141	Mockingbird	*Mimus polyglottos*
142	Mountain bluebird	*Sialia currucoides*
143	Mountain plover	*Charadrius montanus*
144	Mourning dove	*Zenaida macroura*
145	Northern harrier	*Circus cyaneus*
146	Northern oriole	*Icterus galbula*
147	Northern phalarope	*Lobipes lobatus*
148	Northern shoveler	*Anas clypeata*
149	Northern waterthrush	*Seiurus noveboracensis*
150	Orange-crowned warbler	*Vermivora celata*
151	Painted redstart	*Myioborus pictus*
152	Phainopepla	*Phainopepla nitens*
153	Pied-billed grebe	*Podilymbus podiceps*
154	Pine siskin	*Carduelis pinus*
155	Pinon jay	*Gymnorhinus cyanocephalus*
156	Pintail	*Anas acuta*
157	Plain titmouse	*Parus inornatus*
158	Poor-will	*Phalaenoptilus nuttallii*
159	Prairie falcon	*Falco mexicanus*
160	Purple finch	*Carpodacus purpureus*
161	Purple martin	*Progne subis*
162	Pygmy nuthatch	*Sitta pygmaea*
163	Pygmy owl	*Glaucidium gnoma*
164	Red-breasted nuthatch	*Sitta canadensis*
165	Red-faced warbler	*Cardellina rubrifrons*
166	Red-tailed hawk	*Buteo jamaicensis*
167	Red-winged blackbird	*Agelaius phoeniceus*
168	Redhead	*Aythya americana*
169	Ring-billed gull	*Larus delawarensis*
170	Ring-necked duck	*Aythya collaris*
171	Roadrunner	*Geococcyx californianus*
172	Rock dove	*Columba livia*
173	Rock wren	*Salpinctes obsoletus*
174	Roseate spoonbill	*Ajaia ajaja*
175	Rough-winged swallow	*Stelgidopteryx ruficollis*
176	Ruby-crowned kinglet	*Regulus calendula*
177	Ruddy duck	*Oxyura jamaicensis*
178	Rufous hummingbird	*Selasphorus rufus*
179	Rufous-crowned sparrow	*Aimophila ruficeps*
180	Rufous-sided towhee	*Pipilo erythrophthalmus*
181	Sage sparrow	*Amphispiza belli*

Appendix I. (continued)

Species no.	Species common name	Species scientific name
182	Sage thrasher	*Oreoscoptes montanus*
183	Savannah sparrow	*Passerculus sandwichensis*
184	Saw-whet owl	*Aegolius acadicus*
185	Say's phoebe	*Sayornis saya*
186	Scott's oriole	*Icterus parisorum*
187	Screech owl	*Otus asio*
188	Scrub jay	*Aphelocoma coerulescens*
189	Sharp-shinned hawk	*Accipiter striatus*
190	Snow goose	*Chen caerulescens*
191	Snowy egret	*Egretta thula*
192	Solitary sandpiper	*Tringa solitaria*
193	Solitary vireo	*Vireo solitarius*
194	Song sparrow	*Melospiza melodia*
195	Sora	*Porzana carolina*
196	Spotted owl	*Strix occidentalis*
197	Spotted sandpiper	*Actitis macularia*
198	Starling	*Sturnus vulgaris*
199	Steller's jay	*Cyanocitta stelleri*
200	Summer tanager	*Piranga rubra*
201	Swainson's thrush	*Catharus ustulatus*
202	Townsend's solitaire	*Myadestes townsendi*
203	Townsend's warbler	*Dendroica townsendi*
204	Tree swallow	*Iridoprocne bicolor*
205	Turkey vulture	*Cathartes aura*
206	Vaux's swift	*Chaetura vauxi*
207	Verdin	*Auriparus flaviceps*
208	Vermilion flycatcher	*Pyrocephalus rubinus*
209	Vesper sparrow	*Pooecetes gramineus*
210	Violet-green swallow	*Tachycineta thalassina*
211	Virginia's warbler	*Vermivora virginiae*
212	Warbling vireo	*Vireo gilvus*
213	Water pipit	*Anthus spinoletta*
214	Western bluebird	*Sialia mexicana*
215	Western flycatcher	*Empidonax difficilis*
216	Western grebe	*Aechmophorus occidentalis*
217	Western kingbird	*Tyrannus verticalis*
218	Western meadowlark	*Sturnella neglecta*
219	Western sandpiper	*Calidris mauri*
220	Western tanager	*Piranga ludoviciana*
221	Western wood pewee	*Contopus sordidulus*
222	Whip-poor-will	*Caprimulgus vociferus*
223	Whistling swan	*Olor columbianus*
224	White pelican	*Pelecanus erythrorhynchos*
225	White-breasted nuthatch	*Sitta carolinensis*
226	White-crowned sparrow	*Zonotrichia leucophrys*
227	White-faced ibis	*Plegadis chihi*

Species no.	Species common name	Species scientific name
228	White-throated swift	*Aeronautes saxatalis*
229	White-winged dove	*Zenaida asiatica*
230	Wied's crested flycatcher	*Myiarchus tyrannulus*
231	Willet	*Catoptrophorus semipalmatus*
232	Williamson's sapsucker	*Sphyrapicus thyroideus*
233	Willow flycatcher	*Empidonax traillii*
234	Wilson's phalarope	*Steganopus tricolor*
235	Wilson's warbler	*Wilsonia pusilla*
236	Yellow warbler	*Dendroica petechia*
237	Yellow-bellied sapsucker	*Sphyrapicus varius*
238	Yellow-billed cuckoo	*Coccyzus americanus*
239	Yellow-breasted chat	*Icteria virens*
240	Yellow-headed blackbird	*Xanthocephalus xanthocephalus*
241	Yellow-rumped warbler	*Dendroica coronata*
242	Zone-tailed hawk	*Buteo albonotatus*
Mammals		
243	Abert's squirrel	*Sciurus aberti*
244	Arizona pocket mouse	*Perognathus amplus*
245	Arizona woodrat	*Neotoma lepida*
246	Badger	*Taxidea taxus*
247	Bailey's pocket mouse	*Perognathus baileyi*
248	Beaver	*Castor canadensis*
249	Big brown bat	*Eptesicus fuscus*
250	Bighorn sheep	*Ovis canadensis*
251	Black bear	*Ursus americanus*
252	Black-tailed jack rabbit	*Lepus californicus*
253	Bobcat	*Felis rufus*
254	Botta's pocket gopher	*Thomomys bottae*
255	Brazilian free-tailed bat	*Tadarida brasiliensis*
256	Brush mouse	*Peromyscus boylii*
257	Burro	*Equus asinus*
258	Cactus mouse	*Peromyscus eremicus*
259	California leaf-nosed bat	*Macrotus californicus*
260	California myotis	*Myotis californicus*
261	Canyon mouse	*Peromyscus crinitus*
262	Cattle	*Bos* sp.
263	Cave myotis	*Myotis velifer*
264	Cliff chipmunk	*Eutamias dorsalis*
265	Collared peccary	*Dicotyles tajacu*
266	Coyote	*Canis latrans*
267	Deer mouse	*Peromyscus maniculatus*
268	Desert cottontail	*Sylvilagus audubonii*
269	Desert pocket mouse	*Perognathus penicillatus*
270	Desert shrew	*Notiosorex crawfordi*
271	Eastern cottontail	*Sylvilagus floridanus*
272	Elk	*Cervus elaphus*

Appendix I. (continued)

Species no.	Species common name	Species scientific name
273	Fringed myotis	*Myotis thysanodes*
274	Gray fox	*Urocyon cinereoargenteus*
275	Harris' antelope squirrel	*Ammospermophilus harrisii*
276	Hoary bat	*Lasiurus cinereus*
277	Hog-nosed skunk	*Conepatus mesoleucus*
278	House mouse	*Mus musculus*
279	Kit fox	*Vulpes macrotis*
280	Little brown myotis	*Myotis lucifugus*
281	Long-eared myotis	*Myotis evotis*
282	Long-legged myotis	*Myotis volans*
283	Merriam's kangaroo rat	*Dipodomys merriami*
284	Mexican vole	*Microtus mexicanus*
285	Mexican woodrat	*Neotoma mexicana*
286	Mountain lion	*Felis concolor*
287	Mule deer	*Odocoileus hemionus*
288	Muskrat	*Ondatra zibethicus*
289	Northern grasshopper mouse	*Onychomys leucogaster*
290	Ord's kangaroo rat	*Dipodomys ordii*
291	Pallid bat	*Antrozous pallidus*
292	Pinon mouse	*Peromyscus truei*
293	Porcupine	*Erethizon dorsatum*
294	Pronghorn	*Antilocapra americana*
295	Raccoon	*Procyon lotor*
296	Red bat	*Lasiurus borealis*
297	Ringtail	*Bassariscus astutus*
298	Rock pocket mouse	*Perognathus intermedius*
299	Rock squirrel	*Spermophilus variegatus*
300	Round-tailed ground squirrel	*Spermophilus tereticaudus*
301	Silky pocket mouse	*Perognathus flavus*
302	Small-footed myotis	*Myotis leibii*
303	Southern grasshopper mouse	*Onychomys torridus*
304	Spotted bat	*Euderma maculatum*
305	Stephen's woodrat	*Neotoma stephensi*
306	Striped skunk	*Mephitis mephitis*
307	Townsend's big-eared bat	*Plecotus townsendii*
308	Western harvest mouse	*Reithrodontomys megalotis*
309	Western pipistrelle	*Pipistrellus hesperus*
310	Western spotted skunk	*Spilogale gracilis*
311	White-throated woodrat	*Neotoma albigula*
312	Yuma myotis	*Myotis yumanensis*
Reptiles and Amphibians		
313	Arizona black rattlesnake	*Crotalus viridis*
314	Arizona night lizard	*Xantusia arizonae*
315	Banded gecko	*Coleonyx variegatus*
316	Black-necked garter snake	*Thamnophis cyrtopsis*
317	Black-tailed rattlesnake	*Crotalus molossus*

Species no.	Species common name	Species scientific name
318	California king snake	*Lampropeltis getulus*
319	California whiptail	*Cnemidophorus tigris*
320	Canyon tree frog	*Hyla arenicolor*
321	Checkered garter snake	*Thamnophis marcianus*
322	Chihuahuan whiptail	*Cnemidophorus* sp.
323	Chuckwalla	*Sauromalus obesus*
324	Coachwhip	*Masticophis flagellum*
325	Collared lizard	*Crotaphytus collaris*
326	Colorado river toad	*Bufo alvarius*
327	Coral snake	*Micruroides euryxanthus*
328	Couch's spadefoot toad	*Scaphiopus couchi*
329	Desert horned lizard	*Phrynosoma platyrhinos*
330	Desert iguana	*Dipsosaurus dorsalis*
331	Desert night lizard	*Xantusia vigilis*
332	Desert spiny lizard	*Sceloporus magister*
333	Desert tortoise	*Gopherus agassizi*
334	Gila monster	*Heloderma suspectum*
335	Gilbert's skink	*Eumeces gilberti*
336	Glossy snake	*Arizona elegans*
337	Gopher snake	*Pituophis catenifer*
338	Great Plains skink	*Eumeces obsoletus*
339	Greater earless lizard	*Cophasaurus texana*
340	Leopard frog	*Rana pipiens*
341	Leopard lizard	*Gambelia wislizenii*
342	Long-nosed snake	*Rhinocheilus lecontei*
343	Long-tail brush lizard	*Urosaurus graciosus*
344	Lyre snake	*Trimorphodon lambda*
345	Mexican black-headed snake	*Tantilla atriceps*
346	Mohave rattlesnake	*Crotalus scutulatus*
347	Mountain king snake	*Lampropeltis pyromelana*
348	Night snake	*Hypsiglena torquata*
349	Plateau whiptail	*Cnemidophorus velox*
350	Red-spotted toad	*Bufo punctatus*
351	Regal horned lizard	*Phrynosoma solare*
352	Ring-neck snake	*Diadophis punctatus*
353	Rosy boa	*Lichanura roseofusca*
354	Short-horned lizard	*Phrynosoma douglassi*
355	Side-blotched lizard	*Uta stansburiana*
356	Sidewinder	*Crotalus cerastes*
357	Soft-shelled turtle	*Trionyx spiniferus*
358	Sonora mud turtle	*Kinosternon sonoriense*
359	Sonora whipsnake	*Masticophis bilineatus*
360	Southern plateau lizard	*Sceloporus undulatus*
361	Southwest toad	*Bufo microscaphus*
362	Speckled rattlesnake	*Crotalus mitchelli*
363	Spotted leaf-nose snake	*Phyllorhynchus decurtatus*
364	Striped racer	*Masticophis lateralis*
365	Striped whipsnake	*Masticophis taeniatus*

Appendix I. (continued)

Species no.	Species common name	Species scientific name
366	Tiger salamander	*Ambystoma tigrinum*
367	Tree lizard	*Urosaurus ornatus*
368	Western blind snake	*Leptotyphlops humilis*
369	Western diamondback rattlesnake	*Crotalus atrox*
370	Western ground snake	*Sonora semiannulata*
371	Western patch-nosed snake	*Salvadora hexalepis*
372	Western shovel-nose snake	*Chionactis occipitalis*
373	Woodhouse's toad	*Bufo woodhousei*
374	Yellow mud turtle	*Kinosternon flavescens*
375	Zebra-tailed lizard	*Callisaurus draconoides*
Fish		
376	Black bullhead	*Ictalurus melas*
377	Bluegill sunfish	*Lepomis macrochirus*
378	Carp	*Cyprinus carpio*
379	Channel catfish	*Ictalurus punctatus*
380	Gila mountain-sucker	*Pantosteus clarki*
381	Gila sucker	*Catostomus insignis*
382	Golden shiner	*Notemigonus crysoleucus*
383	Goldfish	*Carassius auratus*
384	Green sunfish	*Chaenobryttus cyanellus*
385	Largemouth bass	*Micropterus salmoides*
386	Longfin dace	*Agosia chrysogaster*
387	Mosquitofish	*Gambusia affinis*
388	Mozambique mouthbrooder	*Tilapia mossambica*
389	Red shiner	*Notropis lutrensis*
390	Roundtail chub	*Gila robusta*
391	Speckled dace	*Rhinichthys osculus*
392	Threadfin shad	*Dorosoma petenense*
393	Yellow bullhead	*Ictalurus natalis*

Appendix II. Vertebrate species that breed and/or feed in each of 14 habitat types in westcentral Arizona.

SPECIES COMMON NAME	HABITAT TYPES USED														NO. USED
	C	CW	CWB	DG	JMS	JTC	L	MBLR	MRS	MT	PJ	PP	PPMC	SPV	
BIRDS:															
ABERT'S TOWHEE		CW								MT					2
ACORN WOODPECKER	C	CW			JMS			MBLR			PJ	PP	PPMC		7
AMERICAN AVOCET							L			MT					2
AMERICAN BITTERN		CW						MBLR		MT					3
AMERICAN COOT		CW					L			MT					3
AMERICAN GOLDFINCH	C	CW		DG	JMS			MBLR		MT	PJ				7
AMERICAN KESTREL	C	CW	CWB	DG	JMS	JTC		MBLR	MRS	MT	PJ	PP	PPMC	SPV	13
AMERICAN REDSTART		CW						MBLR		MT					3
AMERICAN ROBIN	C	CW		DG	JMS			MBLR	MRS	MT	PJ	PP	PPMC		10
AMERICAN WIGEON							L			MT					2
ANNA'S HUMMINGBIRD	C	CW	CWB	DG	JMS	JTC		MBLR	MRS	MT	PJ	PP	PPMC	SPV	13
ASH-THROATED FLYCATCHER	C	CW	CWB	DG	JMS	JTC		MBLR	MRS	MT	PJ	PP		SPV	12
BAIRD'S SANDPIPER							L			MT					2
BALD EAGLE		CW		DG			L	MBLR						SPV	5
BAND-TAILED PIGEON												PP	PPMC		2
BARN OWL		CW	CWB	DG				MBLR	MRS	MT				SPV	7
BARN SWALLOW	C	CW	CWB	DG	JMS	JTC	L	MBLR	MRS	MT	PJ	PP	PPMC	SPV	14
BELL'S VIREO		CW						MBLR		MT					3
BELTED KINGFISHER		CW					L	MBLR		MT					4
BENDIRE'S THRASHER			CWB			JTC			MRS					SPV	4
BEWICK'S WREN	C	CW			JMS	JTC		MBLR	MRS	MT	PJ	PP	PPMC	SPV	11
BLACK HAWK		CW						MBLR							2
BLACK PHOEBE		CW					L	MBLR		MT					4
BLACK SWIFT	C	CW	CWB	DG	JMS	JTC	L	MBLR	MRS	MT	PJ	PP	PPMC	SPV	14
BLACK TERN							L								1
BLACK-CHINNED HUMMINGBIRD	C	CW	CWB	DG	JMS	JTC		MBLR	MRS	MT	PJ			SPV	11
BLACK-CHINNED SPARROW	C				JMS						PJ				3
BLACK-CROWNED NIGHT HERON		CW					L	MBLR		MT					4
BLACK-HEADED GROSBEAK	C				JMS	JTC		MBLR	MRS	MT	PJ	PP	PPMC	SPV	10
BLACK-NECKED STILT							L			MT					2
BLACK-TAILED GNATCATCHER		CW	CWB		JMS	JTC			MRS	MT				SPV	7
BLACK-THROATED GRAY WARBLER	C	CW			JMS			MBLR	MRS	MT	PJ	PP	PPMC		9
BLACK-THROATED SPARROW	C		CWB		JMS	JTC			MRS	MT				SPV	7
BLUE GROSBEAK	C	CW			JMS			MBLR	MRS			PP	PPMC		7
BLUE-GRAY GNATCATCHER	C	CW	CWB	DG	JMS	JTC		MBLR	MRS	MT	PJ	PP	PPMC	SPV	13
BLUE-WINGED TEAL							L			MT					2
BONAPARTE'S GULL							L								1
BREWER'S BLACKBIRD		CW	CWB				L			MT					4
BREWER'S SPARROW	C		CWB	DG	JMS	JTC			MRS	MT				SPV	8
BRIDLED TITMOUSE		CW						MBLR		MT					3
BROAD-TAILED HUMMINGBIRD	C	CW			JMS			MBLR			PJ	PP	PPMC		7
BROWN CREEPER		CW						MBLR			PJ	PP	PPMC		5
BROWN TOWHEE	C				JMS	JTC			MRS	MT	PJ			SPV	7
BROWN-HEADED COWBIRD	C	CW	CWB	DG	JMS	JTC		MBLR	MRS	MT	PJ			SPV	11
BUFFLEHEAD							L								1
BURROWING OWL			CWB	DG											2
BUSHTIT	C	CW		DG	JMS	JTC		MBLR	MRS	MT	PJ	PP	PPMC	SPV	12

Appendix II. (continued).

SPECIES COMMON NAME	HABITAT TYPES USED														NO. USED
CACTUS WREN	C	CW	CWB	DG	JMS	JTC		MBLR	MRS	MT	PJ	PP		SPV	12
CALLIOPE HUMMINGBIRD	C	CW			JMS			MBLR			PJ	PP	PPMC		7
CANADA GOOSE		CW					L	MBLR		MT					4
CANVASBACK							L			MT					2
CANYON WREN	C	CW	CWB	DG	JMS	JTC		MBLR	MRS	MT	PJ			SPV	11
CARDINAL		CW						MBLR	MRS	MT					4
CASSIN'S FINCH		CW						MBLR			PJ	PP	PPMC		5
CASSIN'S KINGBIRD	C	CW		DG	JMS			MBLR		MT	PJ	PP	PPMC		9
CEDAR WAXWING		CW			JMS			MBLR			PJ	PP	PPMC		6
CHESTNUT-COLLARED LONGSPUR				DG											1
CHIPPING SPARROW	C	CW	CWB		JMS	JTC		MBLR	MRS	MT	PJ	PP	PPMC	SPV	12
CINNAMON TEAL		CW					L	MBLR		MT					4
CLARK'S NUTCRACKER								MBLR			PJ	PP	PPMC		4
CLIFF SWALLOW	C	CW	CWB	DG	JMS	JTC	L	MBLR	MRS	MT	PJ	PP	PPMC	SPV	14
COMMON CROW		CW		DG	JMS					MT					4
COMMON FLICKER	C	CW	CWB	DG	JMS	JTC		MBLR	MRS	MT	PJ	PP	PPMC	SPV	13
COMMON GALLINULE										MT					1
COMMON GOLDENEYE							L								1
COMMON LOON							L								1
COMMON MERGANSER		CW					L	MBLR							3
COMMON NIGHTHAWK												PP	PPMC		2
COMMON RAVEN	C	CW	CWB	DG	JMS	JTC		MBLR	MRS	MT	PJ	PP	PPMC	SPV	13
COMMON SNIPE							L			MT					2
COMMON YELLOWTHROAT	C	CW			JMS			MBLR	MRS	MT	PJ				7
COOPER'S HAWK	C	CW	CWB	DG	JMS	JTC		MBLR	MRS	MT	PJ	PP	PPMC	SPV	13
COSTA'S HUMMINGBIRD	C	CW	CWB	DG	JMS	JTC		MBLR	MRS	MT				SPV	10
CRISSAL THRASHER	C	CW			JMS			MBLR	MRS	MT	PJ				7
CURVE-BILLED THRASHER			CWB	DG	JMS	JTC			MRS	MT				SPV	7
DARK-EYED JUNCO	C	CW	CWB		JMS	JTC		MBLR	MRS	MT	PJ	PP	PPMC	SPV	12
DIPPER		CW						MBLR							2
DOUBLE-CRESTED CORMORANT		CW					L			MT					3
DOWNY WOODPECKER								MBLR				PP	PPMC		3
DUNLIN							L			MT					2
DUSKY FLYCATCHER	C	CW			JMS	JTC		MBLR	MRS	MT	PJ	PP	PPMC	SPV	11
EARED GREBE		CW					L	MBLR		MT					4
EASTERN MEADOWLARK				DG											1
ELF OWL		CW			JMS			MBLR	MRS	MT				SPV	6
FERRUGINOUS HAWK				DG											1
FLAMMULATED OWL										MT		PP	PPMC		3
FORSTER'S TERN							L								1
FOX SPARROW	C	CW			JMS			MBLR			PJ				5
GADWALL		CW					L	MBLR		MT					4
GAMBEL'S QUAIL	C	CW	CWB	DG	JMS	JTC		MBLR	MRS	MT	PJ			SPV	11
GILA WOODPECKER		CW			JMS	JTC		MBLR	MRS	MT				SPV	7
GOLDEN EAGLE	C		CWB	DG	JMS	JTC					PJ	PP	PPMC	SPV	9
GOLDEN-CROWNED KINGLET		CW						MBLR			PJ	PP	PPMC		5
GOSHAWK	C				JMS					MT	PJ	PP	PPMC		6
GRACE'S WARBLER								MBLR			PJ	PP	PPMC		4
GRAY FLYCATCHER	C	CW			JMS	JTC		MBLR	MRS	MT	PJ	PP	PPMC	SPV	11
GRAY VIREO	C				JMS			MBLR			PJ	PP			5

Appendix II. (continued).

SPECIES COMMON NAME	HABITAT TYPES USED														NO. USED
	C	CW	CWB	DG	JMS	JTC	L	MBLR	MRS	MT	PJ	PP	PPMC	SPV	
GREAT BLUE HERON		CW					L	MBLR		MT					4
GREAT EGRET		CW					L	MBLR		MT					4
GREAT HORNED OWL	C	CW	CWB	DG	JMS	JTC		MBLR	MRS	MT	PJ	PP	PPMC	SPV	13
GREAT-TAILED GRACKLE		CW	CWB							MT					3
GREATER SCAUP							L								1
GREATER YELLOWLEGS							L			MT					2
GREEN HERON		CW					L	MBLR		MT					4
GREEN-TAILED TOWHEE	C	CW			JMS			MBLR	MRS	MT	PJ	PP	PPMC		9
GREEN-WINCED TEAL							L			MT					2
HAIRY WOODPECKER		CW						MBLR			PJ	PP	PPMC		5
HAMMOND'S FLYCATCHER	C	CW			JMS	JTC		MBLR	MRS	MT	PJ	PP	PPMC	SPV	11
HEPATIC TANAGER	C				JMS						PJ	PP	PPMC		5
HERMIT THRUSH	C	CW			JMS	JTC		MBLR	MRS	MT	PJ	PP	PPMC	SPV	11
HERMIT WARBLER	C	CW			JMS			MBLR	MRS	MT	PJ	PP	PPMC		9
HOODED ORIOLE	C	CW			JMS	JTC		MBLR	MRS	MT	PJ			SPV	9
HORNED GREBE							L								1
HORNED LARK			CWB	DG											2
HOUSE FINCH	C	CW	CWB	DG	JMS	JTC		MBLR	MRS	MT	PJ	PP	PPMC	SPV	13
HOUSE SPARROW		CW								MT					2
HOUSE WREN	C	CW			JMS			MBLR		MT	PJ	PP	PPMC		8
KILLDEER		CW						MBLR		MT					3
LADDER-BACKED WOODPECKER	C	CW	CWB	DG	JMS	JTC		MBLR	MRS	MT	PJ			SPV	11
LARK BUNTING			CWB	DG											2
LARK SPARROW	C		CWB	DG	JMS	JTC			MRS	MT	PJ			SPV	9
LAWRENCE'S GOLDFINCH		CW								MT					2
LAZULI BUNTING	C	CW			JMS			MBLR	MRS	MT	PJ	PP			8
LEAST BITTERN		CW						MBLR		MT					3
LEAST FLYCATCHER	C	CW			JMS	JTC		MBLR	MRS	MT	PJ	PP	PPMC	SPV	11
LEAST SANDPIPER							L			MT					2
LESSER GOLDFINCH	C	CW	CWB	DG		JTC		MBLR	MRS	MT	PJ	PP	PPMC	SPV	12
LESSER NIGHTHAWK	C	CW	CWB	DG	JMS	JTC			MRS	MT				SPV	9
LESSER SCAUP							L								1
LEWIS' WOODPECKER	C	CW			JMS	JTC		MBLR	MRS	MT	PJ	PP	PPMC	SPV	11
LINCOLN'S SPARROW		CW						MBLR	MRS	MT					4
LOGGERHEAD SHRIKE	C	CW	CWB	DG	JMS	JTC			MRS	MT	PJ			SPV	10
LONG-BILLED CURLEW			CWB	DG						MT					3
LONG-BILLED DOWITCHER							L			MT					2
LONG-BILLED MARSH WREN		CW						MBLR		MT					3
LONG-EARED OWL	C	CW	CWB	DG	JMS	JTC		MBLR		MT	PJ	PP	PPMC	SPV	12
LUCY'S WARBLER	C	CW	CWB	DG	JMS	JTC		MBLR	MRS	MT	PJ			SPV	11
MACGILLIVRAY'S WARBLER	C	CW			JMS	JTC		MBLR	MRS	MT	PJ	PP	PPMC	SPV	11
MALLARD		CW					L	MBLR		MT					4
MERLIN				DG											1
MOCKINGBIRD	C	CW	CWB	DG	JMS	JTC			MRS	MT	PJ			SPV	10
MOUNTAIN BLUEBIRD	C	CW	CWB	DG	JMS	JTC		MBLR	MRS	MT	PJ	PP	PPMC	SPV	13
MOUNTAIN PLOVER			CWB	DG											2
MOURNING DOVE	C	CW	CWB	DG	JMS	JTC		MBLR	MRS	MT	PJ	PP	PPMC	SPV	13
NORTHERN HARRIER			CWB	DG											2
NORTHERN ORIOLE	C	CW			JMS	JTC		MBLR	MRS	MT	PJ			SPV	9

Appendix II. (continued).

SPECIES COMMON NAME	HABITAT TYPES USED														NO. USED
	C	CW	CWB	DG	JMS	JTC	L	MBLR	MRS	MT	PJ	PP	PPMC	SPV	
NORTHERN PHALAROPE							L								1
NORTHERN SHOVELER		CW					L	MBLR		MT					4
NORTHERN WATERTHRUSH		CW						MBLR		MT					3
ORANGE-CROWNED WARBLER	C	CW			JMS			MBLR	MRS	MT	PJ	PP	PPMC		9
PAINTED REDSTART	C	CW			JMS			MBLR			PJ	PP	PPMC		7
PHAINOPEPLA	C	CW	CWB		JMS	JTC		MBLR	MRS	MT	PJ			SPV	10
PIED-BILLED GREBE		CW					L	MBLR		MT					4
PINE SISKIN		CW			JMS			MBLR			PJ	PP	PPMC		6
PINON JAY	C				JMS			MBLR			PJ	PP	PPMC		6
PINTAIL							L			MT					2
PLAIN TITMOUSE	C	CW			JMS			MBLR			PJ	PP			6
POOR-WILL	C				JMS	JTC					PJ			SPV	5
PRAIRIE FALCON	C		CWB	DG	JMS	JTC					PJ	PP	PPMC	SPV	9
PURPLE FINCH	C	CW			JMS			MBLR		MT	PJ	PP	PPMC		8
PURPLE MARTIN								MBLR			PJ	PP	PPMC		4
PYGMY NUTHATCH								MBLR			PJ	PP	PPMC		4
PYGMY OWL								MBLR				PP	PPMC		3
RED-BREASTED NUTHATCH								MBLR			PJ	PP	PPMC		4
RED-FACED WARBLER								MBLR			PJ	PP	PPMC		4
RED-TAILED HAWK	C	CW	CWB	DG	JMS	JTC		MBLR	MRS	MT	PJ	PP	PPMC	SPV	13
RED-WINGED BLACKBIRD		CW	CWB				L			MT					4
REDHEAD							L			MT					2
RING-BILLED GULL							L								1
RING-NECKED DUCK							L			MT					2
ROADRUNNER	C	CW	CWB	DG	JMS	JTC		MBLR	MRS	MT	PJ			SPV	11
ROCK DOVE	C	CW	CWB	DG	JMS	JTC		MBLR	MRS	MT	PJ	PP	PPMC	SPV	13
ROCK WREN	C	CW	CWB	DG	JMS	JTC		MBLR	MRS	MT	PJ	PP	PPMC	SPV	13
ROSEATE SPOONBILL							L								1
ROUGH-WINGED SWALLOW	C	CW	CWB	DG	JMS	JTC	L	MBLR	MRS	MT	PJ	PP	PPMC	SPV	14
RUBY-CROWNED KINGLET	C	CW	CWB	DG	JMS	JTC		MBLR	MRS	MT	PJ	PP	PPMC	SPV	13
RUDDY DUCK							L			MT					2
RUFOUS HUMMINGBIRD	C	CW			JMS			MBLR			PJ	PP	PPMC		7
RUFOUS-CROWNED SPARROW	C				JMS						PJ				3
RUFOUS-SIDED TOWHEE	C	CW			JMS			MBLR			PJ	PP	PPMC		7
SAGE SPARROW			CWB	DG		JTC			MRS	MT				SPV	6
SAGE THRASHER			CWB	DG	JMS	JTC			MRS	MT				SPV	7
SAVANNAH SPARROW			CWB	DG						MT					3
SAW-WHET OWL										MT			PPMC		2
SAY'S PHOEBE	C	CW	CWB	DG	JMS	JTC		MBLR	MRS	MT	PJ	PP	PPMC	SPV	13
SCOTT'S ORIOLE	C	CW		DG	JMS	JTC			MRS	MT	PJ			SPV	9
SCREECH OWL	C	CW	CWB		JMS	JTC		MBLR	MRS	MT	PJ			SPV	10
SCRUB JAY	C	CW		DG	JMS			MBLR			PJ	PP	PPMC		8
SHARP-SHINNED HAWK	C	CW	CWB		JMS	JTC		MBLR	MRS	MT	PJ	PP	PPMC	SPV	12
SNOW GOOSE							L								1
SNOWY EGRET		CW					L	MBLR		MT					4
SOLITARY SANDPIPER							L			MT					2
SOLITARY VIREO	C	CW			JMS			MBLR	MRS	MT	PJ	PP	PPMC		9
SONG SPARROW		CW								MT					2
SORA										MT					1
SPOTTED OWL												PP	PPMC		2
SPOTTED SANDPIPER		CW					L	MBLR		MT					4

Appendix II. (continued).

SPECIES COMMON NAME	HABITAT TYPES USED														NO. USED
STARLING	C	CW	CWB	DG	JMS	JTC			MRS	MT	PJ			SPV	10
STELLER'S JAY	C	CW			JMS			MBLR			PJ	PP	PPMC		7
SUMMER TANAGER		CW						MBLR		MT					3
SWAINSON'S THRUSH	C	CW			JMS	JTC		MBLR	MRS	MT	PJ	PP	PPMC	SPV	11
TOWNSEND'S SOLITAIRE	C	CW			JMS			MBLR			PJ	PP	PPMC		7
TOWNSEND'S WARBLER	C	CW			JMS	JTC		MBLR	MRS	MT	PJ	PP	PPMC	SPV	11
TREE SWALLOW	C	CW	CWB	DG	JMS	JTC	L	MBLR	MRS	MT	PJ	PP	PPMC	SPV	14
TURKEY VULTURE	C	CW	CWB	DG	JMS	JTC		MBLR	MRS	MT	PJ	PP	PPMC	SPV	13
VAUX'S SWIFT	C	CW	CWB	DG	JMS	JTC	L	MBLR	MRS	MT	PJ	PP	PPMC	SPV	14
VERDIN	C	CW	CWB		JMS	JTC		MBLR	MRS	MT	PJ			SPV	10
VERMILION FLYCATCHER		CW						MBLR	MRS	MT					4
VESPER SPARROW				DG											1
VIOLET-GREEN SWALLOW	C	CW	CWB	DG	JMS	JTC	L	MBLR	MRS	MT	PJ	PP	PPMC	SPV	14
VIRGINIA'S WARBLER	C	CW			JMS			MBLR	MRS	MT	PJ	PP	PPMC		9
WARBLING VIREO	C	CW			JMS			MBLR	MRS	MT	PJ	PP	PPMC		9
WATER PIPIT	C	CW	CWB	DG	JMS	JTC		MBLR	MRS	MT				SPV	10
WESTERN BLUEBIRD	C	CW			JMS	JTC		MBLR	MRS	MT	PJ	PP	PPMC	SPV	11
WESTERN FLYCATCHER	C	CW			JMS	JTC		MBLR	MRS	MT	PJ	PP	PPMC	SPV	11
WESTERN GREBE							L								1
WESTERN KINGBIRD	C	CW	CWB	DG	JMS	JTC		MBLR	MRS	MT	PJ			SPV	11
WESTERN MEADOWLARK	C		CWB	DG	JMS										4
WESTERN SANDPIPER							L								1
WESTERN TANAGER	C	CW			JMS	JTC		MBLR	MRS	MT	PJ	PP	PPMC	SPV	11
WESTERN WOOD PEWEE		CW						MBLR		MT	PJ	PP	PPMC		6
WHIP-POOR-WILL												PP	PPMC		2
WHISTLING SWAN							L								1
WHITE PELICAN							L								1
WHITE-BREASTED NUTHATCH		CW						MBLR			PJ	PP	PPMC		5
WHITE-CROWNED SPARROW	C	CW	CWB	DG	JMS	JTC		MBLR	MRS	MT	PJ	PP	PPMC	SPV	13
WHITE-FACED IBIS		CW					L	MBLR		MT					4
WHITE-THROATED SWIFT	C	CW	CWB	DG	JMS	JTC	L	MBLR	MRS	MT	PJ	PP	PPMC	SPV	14
WHITE-WINGED DOVE	C	CW						MBLR		MT	PJ				5
WIED'S CRESTED FLYCATCHER	C	CW	CWB		JMS	JTC		MBLR	MRS	MT				SPV	9
WILLET							L			MT					2
WILLIAMSON'S SAPSUCKER		CW						MBLR			PJ	PP	PPMC		5
WILLOW FLYCATCHER	C	CW			JMS	JTC		MBLR	MRS	MT	PJ	PP	PPMC	SPV	11
WILSON'S PHALAROPE							L								1
WILSON'S WARBLER	C	CW			JMS	JTC		MBLR	MRS	MT	PJ	PP	PPMC	SPV	11
YELLOW WARBLER		CW						MBLR	MRS	MT					4
YELLOW-BELLIED SAPSUCKER	C	CW			JMS			MBLR	MRS	MT	PJ	PP	PPMC		9
YELLOW-BILLED CUCKOO		CW						MBLR		MT					3
YELLOW-BREASTED CHAT		CW						MBLR		MT					3
YELLOW-HEADED BLACKBIRD		CW	CWB				L			MT					4
YELLOW-RUMPED WARBLER	C	CW	CWB	DG	JMS	JTC		MBLR	MRS	MT	PJ	PP	PPMC	SPV	13
ZONE-TAILED HAWK	C	CW		DG	JMS			MBLR			PJ	PP	PPMC	SPV	9

Appendix II. (continued).

SPECIES COMMON NAME	HABITAT TYPES USED														NO. USED
MAMMALS:															
ABERT'S SQUIRREL												PP	PPMC		2
ARIZONA POCKET MOUSE			CWB	DG	JMS	JTC			MRS	MT				SPV	7
ARIZONA WOODRAT	C	CW	CWB	DG	JMS	JTC		MBLR	MRS	MT	PJ	PP		SPV	12
BADGER	C	CW	CWB	DG	JMS				MRS	MT				SPV	8
BAILEY'S POCKET MOUSE				DG	JMS				MRS	MT				SPV	5
BEAVER		CW						MBLR		MT					3
BIG BROWN BAT	C	CW	CWB	DG	JMS	JTC	L	MBLR	MRS	MT	PJ	PP	PPMC	SPV	14
BIGHORN SHEEP	C		CWB	DG	JMS	JTC			MRS		PJ			SPV	8
BLACK BEAR	C	CW			JMS			MBLR			PJ	PP	PPMC		7
BLACK-TAILED JACK RABBIT	C	CW	CWB	DG	JMS	JTC		MBLR	MRS	MT	PJ	PP		SPV	12
BOBCAT	C	CW	CWB	DG	JMS	JTC		MBLR	MRS	MT	PJ	PP	PPMC	SPV	13
BOTTA'S POCKET GOPHER	C	CW	CWB	DG	JMS	JTC		MBLR	MRS	MT	PJ	PP	PPMC	SPV	13
BRAZILIAN FREE-TAILED BAT	C	CW	CWB	DG	JMS	JTC	L	MBLR	MRS	MT	PJ	PP	PPMC	SPV	14
BRUSH MOUSE	C	CW			JMS			MBLR			PJ	PP	PPMC		7
BURRO		CW	CWB	DG	JMS	JTC			MRS	MT				SPV	8
CACTUS MOUSE	C	CW	CWB	DG	JMS	JTC		MBLR	MRS	MT	PJ			SPV	11
CALIFORNIA LEAF-NOSED BAT		CW	CWB			JTC	L		MRS	MT				SPV	7
CALIFORNIA MYOTIS	C	CW	CWB	DG	JMS	JTC	L	MBLR	MRS	MT	PJ	PP	PPMC	SPV	14
CANYON MOUSE	C	CW	CWB	DG	JMS	JTC			MRS		PJ			SPV	9
CATTLE	C	CW	CWB	DG	JMS	JTC		MBLR	MRS	MT	PJ	PP	PPMC	SPV	13
CAVE MYOTIS	C	CW	CWB	DG	JMS	JTC	L	MBLR	MRS	MT	PJ	PP	PPMC	SPV	14
CLIFF CHIPMUNK	C				JMS			MBLR			PJ	PP	PPMC		6
COLLARED PECCARY	C	CW	CWB	DG	JMS	JTC		MBLR	MRS	MT				SPV	10
COYOTE	C	CW	CWB	DG	JMS	JTC		MBLR	MRS	MT	PJ	PP	PPMC	SPV	13
DEER MOUSE	C	CW		DG				MBLR			PJ	PP			6
DESERT COTTONTAIL	C	CW	CWB	DG	JMS	JTC		MBLR	MRS	MT	PJ	PP	PPMC	SPV	13
DESERT POCKET MOUSE			CWB	DG	JMS	JTC			MRS	MT				SPV	7
DESERT SHREW	C	CW						MBLR	MRS	MT					5
EASTERN COTTONTAIL	C	CW		DG	JMS			MBLR			PJ	PP	PPMC		8
ELK	C										PJ	PP	PPMC		4
FRINGED MYOTIS	C	CW		DG	JMS			MBLR			PJ	PP	PPMC		8
GRAY FOX	C	CW	CWB	DG	JMS	JTC		MBLR	MRS	MT	PJ	PP		SPV	12
HARRIS' ANTELOPE SQUIRREL	C	CW	CWB	DG	JMS	JTC		MBLR	MRS	MT	PJ			SPV	11
HOARY BAT		CW						MBLR			PJ	PP	PPMC		5
HOG-NOSED SKUNK	C	CW						MBLR			PJ	PP	PPMC		6
HOUSE MOUSE	C	CW	CWB	DG	JMS	JTC		MBLR	MRS	MT	PJ	PP	PPMC	SPV	13
KIT FOX			CWB			JTC								SPV	3
LITTLE BROWN MYOTIS								MBLR			PJ	PP	PPMC		4
LONG-EARED MYOTIS								MBLR				PP	PPMC		3
LONG-LEGGED MYOTIS	C	CW		DG	JMS			MBLR			PJ	PP	PPMC		8
MERRIAM'S KANGAROO RAT			CWB	DG	JMS	JTC			MRS	MT				SPV	7
MEXICAN VOLE												PP	PPMC		2
MEXICAN WOODRAT												PP	PPMC		2
MOUNTAIN LION	C	CW	CWB	DG	JMS	JTC		MBLR	MRS		PJ	PP	PPMC	SPV	12
MULE DEER	C	CW	CWB	DG	JMS	JTC		MBLR	MRS	MT	PJ	PP	PPMC	SPV	13
MUSKRAT		CW								MT					2
NORTHERN GRASSHOPPER MOUSE	C			DG	JMS						PJ				4
ORD'S KANGAROO RAT	C			DG											2
PALLID BAT	C	CW	CWB	DG	JMS	JTC	L	MBLR	MRS	MT	PJ	PP	PPMC	SPV	14

Appendix II. (continued).

SPECIES COMMON NAME	HABITAT TYPES USED														NO. USED
	C	CW	CWB	DG	JMS	JTC	L	MBLR	MRS	MT	PJ	PP	PPMC	SPV	
PINON MOUSE					JMS						PJ				2
PORCUPINE		CW			JMS			MBLR	MRS	MT	PJ	PP	PPMC	SPV	9
PRONGHORN			CWB	DG	JMS	JTC									4
RACCOON		CW						MBLR		MT		PP	PPMC		5
RED BAT		CW					L	MBLR		MT		PP	PPMC		6
RINGTAIL	C	CW			JMS			MBLR	MRS	MT	PJ			SPV	8
ROCK POCKET MOUSE		CW			JMS	JTC			MRS	MT				SPV	6
ROCK SQUIRREL	C	CW	CWB	DG	JMS	JTC		MBLR	MRS	MT	PJ	PP	PPMC	SPV	13
ROUND-TAILED GROUND SQUIRREL			CWB		JMS	JTC			MRS	MT				SPV	6
SILKY POCKET MOUSE				DG											1
SMALL-FOOTED MYOTIS	C	CW		DG	JMS			MBLR			PJ	PP	PPMC		8
SOUTHERN GRASSHOPPER MOUSE	C	CW	CWB	DG	JMS	JTC			MRS	MT	PJ			SPV	10
SPOTTED BAT	C	CW		DG	JMS			MBLR		MT	PJ	PP	PPMC		9
STEPHENS' WOODRAT	C			DG	JMS			MBLR			PJ	PP	PPMC		7
STRIPED SKUNK	C	CW	CWB	DG	JMS	JTC		MBLR	MRS	MT	PJ	PP	PPMC	SPV	13
TOWNSEND'S BIG-EARED BAT	C	CW	CWB	DG	JMS	JTC	L	MBLR	MRS	MT	PJ	PP	PPMC	SPV	14
WESTERN HARVEST MOUSE	C	CW	CWB	DG	JMS	JTC		MBLR	MRS	MT	PJ			SPV	11
WESTERN PIPISTRELLE	C	CW	CWB	DG		JTC	L		MRS	MT				SPV	9
WESTERN SPOTTED SKUNK	C	CW	CWB	DG	JMS	JTC		MBLR	MRS	MT	PJ			SPV	11
WHITE-THROATED WOODRAT	C	CW	CWB	DG	JMS	JTC		MBLR	MRS	MT	PJ	PP		SPV	12
YUMA MYOTIS	C	CW		DG	JMS		L	MBLR		MT	PJ	PP	PPMC		10
REPTILES AND AMPHIBIANS:															
ARIZONA BLACK RATTLESNAKE	C			DG							PJ	PP	PPMC		5
ARIZONA NIGHT LIZARD	C										PJ				2
BANDED GECKO			CWB		JMS	JTC								SPV	4
BLACK-NECKED GARTER SNAKE	C	CW	CWB		JMS	JTC		MBLR	MRS	MT	PJ			SPV	10
BLACK-TAILED RATTLESNAKE	C				JMS									SPV	3
CALIFORNIA KING SNAKE		CW	CWB		JMS	JTC		MBLR	MRS	MT	PJ			SPV	9
CALIFORNIA WHIPTAIL	C	CW	CWB	DG	JMS	JTC		MBLR	MRS	MT	PJ	PP	PPMC	SPV	13
CANYON TREE FROG		CW					L	MBLR							3
CHECKERED GARTER SNAKE	C	CW	CWB		JMS	JTC		MBLR	MRS	MT	PJ			SPV	10
CHIHUAHUAN WHIPTAIL	C			DG											2
CHUCKWALLA					JMS	JTC									2
COACHWHIP		CW	CWB		JMS	JTC		MBLR	MRS	MT	PJ			SPV	9
COLLARED LIZARD	C			DG	JMS						PJ			SPV	5
COLORADO RIVER TOAD		CW						MBLR		MT				SPV	4
CORAL SNAKE		CW						MBLR	MRS	MT					4
COUCH'S SPADEFOOT TOAD		CW	CWB	DG			L	MBLR	MRS	MT					7
DESERT HORNED LIZARD			CWB		JMS	JTC								SPV	4
DESERT IGUANA			CWB			JTC								SPV	3
DESERT NIGHT LIZARD					JMS									SPV	2
DESERT SPINY LIZARD	C	CW	CWB	DG	JMS	JTC		MBLR		MT	PJ			SPV	10
DESERT TORTOISE	C				JMS	JTC				MT					4
GILA MONSTER	C				JMS									SPV	3
GILBERT'S SKINK	C	CW		DG				MBLR		MT	PJ	PP	PPMC		8
GLOSSY SNAKE	C	CW	CWB	DG	JMS	JTC		MBLR	MRS	MT	PJ			SPV	11
GOPHER SNAKE	C	CW	CWB		JMS	JTC		MBLR	MRS	MT	PJ			SPV	10
GREAT PLAINS SKINK	C	CW													2
GREATER EARLESS LIZARD	C	CW	CWB	DG	JMS	JTC		MBLR	MRS	MT	PJ			SPV	11

Appendix II. (concluded).

SPECIES COMMON NAME	HABITAT TYPES USED														NO. USED
	C	CW	CWB	DG	JMS	JTC	L	MBLR	MRS	MT	PJ	PP	PPMC	SPV	
LEOPARD FROG		CW					L	MBLR		MT					4
LEOPARD LIZARD					JMS									SPV	2
LONG-NOSED SNAKE	C	CW	CWB		JMS	JTC		MBLR	MRS	MT	PJ			SPV	10
LONG-TAIL BRUSH LIZARD	C	CW	CWB		JMS	JTC		MBLR	MRS	MT	PJ			SPV	10
LYRE SNAKE					JMS									SPV	2
MEXICAN BLACK-HEADED SNAKE	C	CW			JMS			MBLR	MRS	MT					6
MOHAVE RATTLESNAKE		CW	CWB		JMS	JTC		MBLR	MRS	MT	PJ			SPV	9
MOUNTAIN KING SNAKE												PP	PPMC		2
NIGHT SNAKE	C		CWB		JMS	JTC					PJ			SPV	6
PLATEAU WHIPTAIL	C			DG											2
RED-SPOTTED TOAD	C	CW	CWB		JMS	JTC	L	MBLR		MT	PJ			SPV	10
REGAL HORNED LIZARD			CWB			JTC								SPV	3
RING-NECK SNAKE					JMS						PJ			SPV	3
ROSY BOA					JMS									SPV	2
SHORT-HORNED LIZARD	C										PJ	PP	PPMC		4
SIDE-BLOTCHED LIZARD	C	CW	CWB		JMS	JTC		MBLR	MRS	MT	PJ			SPV	10
SIDEWINDER			CWB												1
SOFT-SHELLED TURTLE		CW					L	MBLR							3
SONORA MUD TURTLE		CW					L	MBLR							3
SONORA WHIPSNAKE	C			DG	JMS			MBLR			PJ				5
SOUTHERN PLATEAU LIZARD	C	CW		DG				MBLR				PP	PPMC		6
SOUTHWEST TOAD	C	CW			JMS		L	MBLR		MT		PP	PPMC		8
SPECKLED RATTLESNAKE		CW			JMS									SPV	3
SPOTTED LEAF-NOSE SNAKE		CW	CWB		JMS	JTC		MBLR	MRS	MT				SPV	8
STRIPED RACER	C														1
STRIPED WHIPSNAKE	C				JMS			MBLR			PJ	PP			5
TIGER SALAMANDER							L				PJ	PP	PPMC		4
TREE LIZARD		CW	CWB	DG				MBLR	MRS	MT					6
WESTERN BLIND SNAKE		CW						MBLR	MRS	MT	PJ			SPV	6
WESTERN DIAMONDBACK RATTLESNAKE	C	CW	CWB		JMS	JTC		MBLR	MRS	MT	PJ			SPV	10
WESTERN GROUND SNAKE			CWB	DG	JMS	JTC								SPV	5
WESTERN PATCH-NOSED SNAKE		CW	CWB		JMS	JTC		MBLR	MRS	MT	PJ			SPV	9
WESTERN SHOVEL-NOSE SNAKE			CWB												1
WOODHOUSE'S TOAD							L			MT					2
YELLOW MUD TURTLE		CW						MBLR							2
ZEBRA-TAILED LIZARD	C	CW	CWB	DG	JMS	JTC		MBLR	MRS	MT	PJ			SPV	11
FISH:															
BLACK BULLHEAD		CW					L			MT					3
BLUEGILL SUNFISH							L								1
CARP		CW					L			MT					3
CHANNEL CATFISH							L								1
GILA MOUNTAIN-SUCKER		CW						MBLR		MT					3
GILA SUCKER		CW						MBLR		MT					3
GOLDEN SHINER							L								1
GOLDFISH							L								1
GREEN SUNFISH		CW					L			MT					3
LARGEMOUTH BASS							L								1
LONGFIN DACE		CW						MBLR		MT					3
MOSQUITOFISH							L								1
MOZAMBIQUE MOUTHBROODER							L								1
RED SHINER		CW								MT					2
ROUNDTAIL CHUB		CW						MBLR		MT					3
SPECKLED DACE		CW						MBLR							2
THREADFIN SHAD							L								1
YELLOW BULLHEAD		CW					L			MT					3
TOTAL SPECIES = 393, BY HABITAT:	193	253	140	136	209	148	98	238	161	249	196	154	144	164	

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